LOCKHEED BLACKBIRD

BEYOND THE SECRET MISSIONS

THE MISSING CHAPTERS

PAUL F. CRICKMORE

OSPREY

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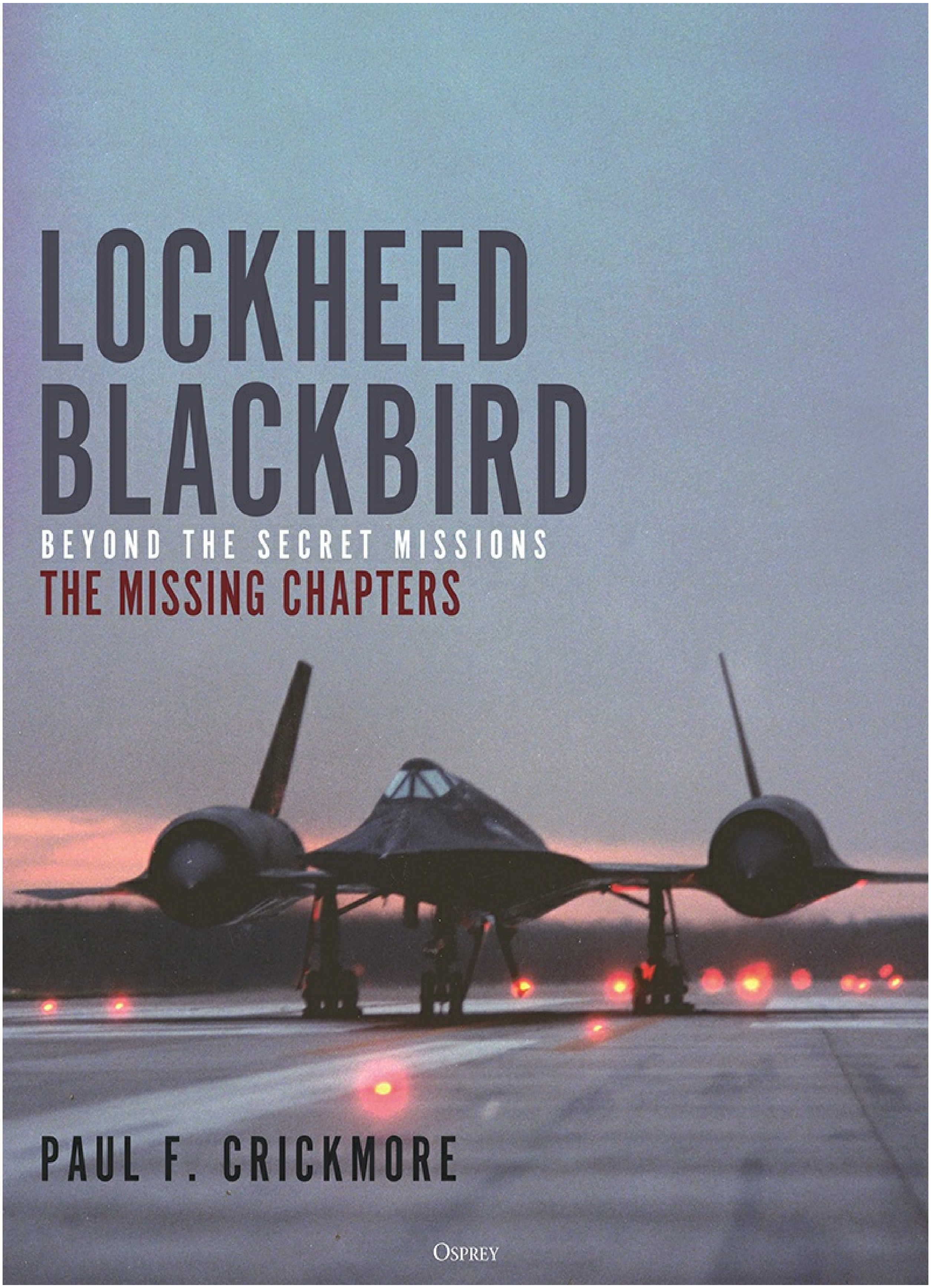

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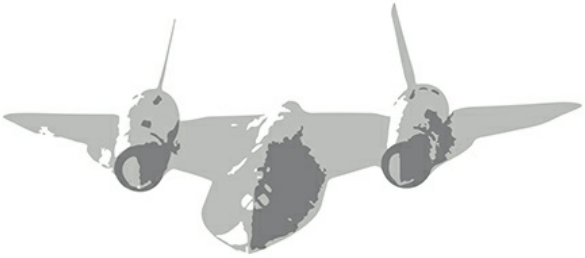
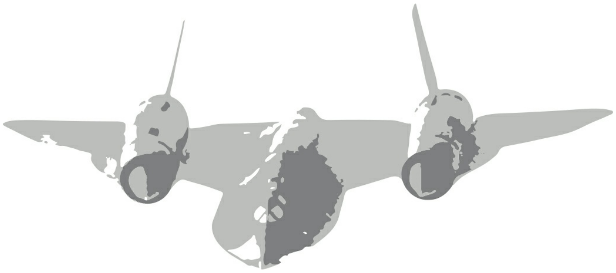


LOCKHEED BLACKBIRD

BEYOND THE SECRET MISSIONS: THE MISSING CHAPTERS

PAUL F. CRICKMORE

FOREWORD BY A. 'BUZ' CARPENTER



DEDICATION

Dedicated to my truly amazing wife Ali, with all my love.
This really will be my last book – honestly!

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ACKNOWLEDGEMENTS

The information contained within this book represents over 35 years of research. I was not connected to any of the Blackbird programmes, therefore without the patient assistance from literally dozens of crewmembers, maintenance specialists and others intimately connected with Oxcart, Tagboard, Kedlock and the Senior Crown programme this, together with other books that I've previously published, would have been impossible to write. This is therefore very much their book, written to a large extent in their words, to record their legacy. Many of those who so freely gave me their time have become lifelong friends; some unfortunately are no longer with us. To them all, both past and present, I offer my most sincere and grateful thanks. Each one has enriched my life immeasurably.

I would like to single out the following who have been especially helpful: Buz Carpenter, Rich Graham, Don Walbrecht, Oxcart pilot Frank Murray, Curt Osterheld, BC Thomas Frank Stampf, 'Mac' McKendree, Ed Yeilding, Mike Relja, Tony Landis, Bob Archer, Lindsay Peacock, Lin Xu, Jay Miller, Tom Veltri and Paul Suhler.

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My thanks are also due to my editors, Marcus Cowper, Cleo Favaretto and Paul E. Eden, and last but by no means least, I'd like to thank Nic, Neil, Pauline, Kevin and Jane, for their endless support. If I've forgotten anyone, please accept my apologies. Any oversight was entirely unintentional and an unfortunate consequence of the overwhelming volume of materials, time and effort that it has taken to create this volume.

Finally, I'd like to take this opportunity to thank all those who have read and enjoyed my previous work on this subject. I sincerely hope that you enjoy reading this book as much as I have enjoyed researching it.

FOREWORD

I began my SR-71 journey in March 1976 with academic coursework and simulator training designed to master the complexities of the fastest air-breathing aircraft ever to see operational service. On 17 June, I was finally in the cockpit for my first flight in SR-71B 61-7956. A year after beginning my training, paired with my long-time friend and RSO John Murphy, I flew my first operational mission out of Kadena Air Base (AB), on 28 March 1977 in 61-7979 on a four-hour sortie along the Korean DMZ. I eventually logged some 230 flights in the Habu (including 67 operational missions), and accumulated 777 total flying hours with 195 hours at Mach 3+. After five years in the programme, my final SR-71 flight was on 3 July 1981.

Colonel A. 'Buz' Carpenter, USAF ret. (USAF)

Thanks to Paul Crickmore and this new edition of his critically acclaimed and authoritative *Lockheed Blackbirds: Beyond the Secret Missions*, you too can share in the history and exhilaration of flying this iconic airplane. Far more than simply a compendium of photos and technical data, Paul puts you in the cockpit to experience – as close as can be – the intensity, the excitement and the elegance of flying combat and peacetime missions of national importance at speeds faster than a rifle bullet and at altitudes nearing the edge of space.

The Blackbird community has never had a better friend than Paul. Although several crewmembers and engineers have written about their experiences – notably Rich Graham and the legendary Ben Rich – Paul is the only aviation historian outside the programme to have earned the trust of the fliers, maintainers, planners and other Blackbird personnel to tell their story. This mutual respect has enabled Paul to assemble their experiences into a single volume that is sure to appeal to aviation enthusiasts, intelligence and policy historians, and especially to family members who waited in unknowing silence during the absence of husbands and fathers who missed birthdays, anniversaries and other special occasions while on the other side of the world putting their lives at risk to fulfil critical national security objectives. It wasn't all serious, however, and crews have shared with Paul the 'above-top-secret' tales of Habu flier hijinx that bonded an elite cohort of fliers while simultaneously 'blowing off steam' back at the 'Q' following intense and stressful missions.

It isn't just pilots and RSOs who figure prominently in this book. Paul shares the experiences of the mission planners at SAC Headquarters, Beale, Kadena, and Mildenhall who spent sleepless nights developing, briefing, refining and justifying (sometimes in vain) the missions that put two men in hostile skies or over frigid waters where survival was measured in minutes and rescue was an impossibility. The men and women of PSD who maintained the 'space suits' that crews wore during each flight are recognized here for their literally life-saving efforts. Military and civilian wrench-turners, Petroleum Oil Lubricants (POL) experts, and the folks who 'kept 'em flying' are equally accounted for. Our missions could never have succeeded without the seldom-told efforts of the 'Team Recce' KC-135Q (and later KC-10) crews who were always on time for more than 26,000 air refuelling contacts over the life of the programme. As soon as the Habu landed it was surrounded by an amazing line-up of maintenance personnel who corrected any post-flight discrepancies and prepared the jet for a quick turn for its next mission, especially at the overseas detachments (Mildenhall had just a single jet for many years). In addition, the 'take' from each sortie was quickly downloaded and processed by some of the best interpreters and analysts in the business. Whether it was electronic signals intelligence associated with Soviet defences in the Baltic that could compromise SAC's Single Integrated Operations Plan to strike the USSR should deterrence fail, or updated imagery of SA-2s in North Vietnam that threatened the next day's strike package, the mission of the SR-71 and the A-12 was straightforward: preserve peace and prevent general war with the Soviet Union and its allies, as well as reduce the danger to US and allied military forces engaged in combat. These objectives and the intelligence collected were directed by and shared with the highest levels of government officials, including six American presidents, their Secretaries of Defense and State, and their Joint Chiefs of Staff.

The Blackbirds were designed during the transition in the aeronautical industry from slide rules to computers, and incorporated technologies and materials that were beyond 'cutting edge'. Kelly Johnson and his Skunk Works team worked magic to convert their imagination of the future to the reality of the present. Despite this – or because of this – the Blackbirds were not easy aircraft to fly. Paul adroitly describes serene flights interrupted by sudden emergencies punctuated by moments of sheer terror. These first-hand accounts – including head-jolting inlet unstarts at Mach 3, multiple systems failures forcing diverts into emergency fields like Bodø, and even pulling the D-ring and 'returning the jet to the taxpayers' – all reflect the cool-headed, practiced training that began in the simulator back at Beale. Make no mistake, Blackbirds were unforgiving of inattention and lack of systems knowledge, but most emergencies were safely resolved through impeccable teamwork between pilot and RSO (and even a tanker crew or two) as well as basic stick-and-rudder skills. Just like the crews once safely back on the ground, Paul's gripping narrative invites the reader to quaff a 'cold one' to recover!

Despite its invaluable contribution to the national security demands of the United States and its allies, the Habu had its share of detractors, and Paul delicately navigates the controversial and – for many – the ill-considered decision to retire the SR-71 not once but twice (and even includes its brief foray into the US Supreme Court).

The Blackbird story is more than the SR-71. Oxcart, Kedlock, Tagboard, Senior Bowl and NASA are all in these pages, the programmes described by those who were there. Through decades of meticulous research using military, corporate and government archival documents (many of which are finally declassified), Paul's book is filled with photographs, maps and tables that add flavour and depth to these remarkable and diverse histories. Although a few gaps remain – as with any 'definitive' history – this book will serve as *the* basis for the next generation of researchers to update.

As a docent and only SR-71 pilot in the Washington DC area working at the Smithsonian Air & Space Museum and the Steven Udvar Hazy Center, I'll make this book my primary recommendation as a guide to a newfound generation of enthusiasts.

It was both an unequalled thrill and a great responsibility to have flown the Habu. To those about to read this magisterial work, you too can share in this extraordinary experience.

Thanks for telling our story, Paul.

A. 'Buz' Carpenter
Fairfax, Virginia

PREFACE

Only 50 Blackbirds of all variants were built. I saw my first member of this elite family, an SR-71, at the Farnborough air show in 1974. From that moment, I was smitten, almost entranced by its evocative, futuristic-looking appearance and mind-boggling performance. A few days earlier, the aircraft parked in front of me had crossed the North Atlantic from New York to London in just one hour 54 minutes and 56 seconds (a world record that stands to this day). I was determined to learn more about this amazing aircraft and so began an association that has lasted for over 40 years.

As a civilian, I feel especially privileged to have been permitted to get close to 'the programme'. My time working in air traffic control at the London Air Traffic Control Centre, based back then at RAF West Drayton, opened for me many fantastic opportunities. I was granted a special security clearance to fly in a KC-135Q tanker, whilst air-to-air refuelling an SR-71 that was operating out of RAF Mildenhall and conducting a secret, operational mission. So, on 6 October 1981, I took my trusty Canon A-1 camera along on a flight that impacted upon my life in ways that I could never have imagined. During the sortie, I was fortunate to have been allowed to photograph the event. Back on watch at LATCC, my dear friend Kev Gothard convinced me to get them published and, after checking that I was not about to break any security regulations, *Air Enthusiast* published a handful.

This led to a request for me to write an article for the same magazine about the SR-71. I had a fair idea about which red lines I'd be ill-advised to cross, and after first sending the final draft to the SR-71 detachment at Mildenhall for review, it was returned with only one or two sentences redacted. The article was followed in 1985 by an invitation from Dennis Baldry, who back then was Osprey's flamboyant aviation editor, to write a book about the aircraft.

Researching that first book took me to Burbank, California, where I spent five days as guest of Ben Rich, Lockheed Skunk Works' boss, interviewing him and others that were involved in the aircraft's design, manufacture and flight test programme. I then travelled to Beale Air Force Base, home of the SR-71, where

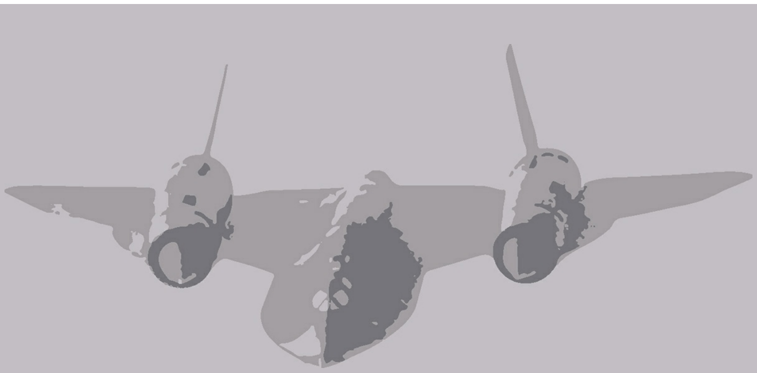
I spent a few days interviewing crewmembers and others that had retired from the programme and lived in the area. We were still in the midst of the 'Cold War' and the SR-71 or Senior Crown programme (as it was known by its USAF operator, Strategic Air Command (SAC)) was tasked with conducting vital, strategic reconnaissance missions in many parts of the world. Much of the data collected was used by the US military to assess an enemy's, or potential enemy's, military capacity and capability. In addition, the data helped to provide accurate, timely information to the US President and government officials, which assisted them in the formulation of US foreign policy: by any measure, this was definitely *not* just a fast military aircraft. Consequently, when writing particularly about the Senior Crown programme, it is important to provide a backdrop of world events at the time particular missions were being flown.

When the SR-71 was officially decommissioned on 26 January 1990, the many friends that I had made within the programmes were able to talk to me more freely about their exploits. In addition, the slow but steady declassification of official documents provided a deeper understanding of how various onboard systems worked. Other declassified documents furnished an appreciation of the 'big picture' behind deployment decisions and the like.

Shortly after launching what I thought would be my last book on the subject in 2016 – the *Lockheed Blackbird: Beyond the Secret Missions*, *Revised Edition* – the CIA declassified a blizzard of documents that included intelligence details that I was staggered to read. This information, together with many other details that I had researched during the intervening years, tied together loose ends and plugged many information gaps, resulting in what will most definitely be my last book about these incredible aircraft programmes.

Many documents relating to the SR-71 programme remain classified secret and are housed at the Air Force Historical Research Agency, located at Maxwell AFB, Alabama. Let's hope that future historians continue to seek these and other documents out, thus keeping the legacy of all those involved in these remarkable programmes alive for many generations to come.

Paul F. Crickmore



CHAPTER 1: THE REQUIREMENT

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UNITED STATES AIR FORCE
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RB-17G 44-8889 was assigned to the 7499th Support Squadron and flew peripheral PHOTINT and some ELINT missions of the Soviet Union around the Baltic and through the west's Berlin corridors. The RB-17Gs were replaced in 1950 by specially converted C-54 Skymasters to carry out a covert reconnaissance gathering role from Wiesbaden AB, West Germany. (USAF)

CONTEXT

Out of necessity, World War II forged an uneasy alliance between two conflicting ideologies: the democratic Western Allies and Joseph Stalin's communist Union of Soviet Socialist Republics (USSR). Together, these two formidable power blocks defeated the odious cancer of Nazism and pan-Pacific imperialism, undoubtedly saving the world from 'a new Dark Age'. However, at the end of WWII, the relationship once again became increasingly frosty, as suspicion, distrust and paranoia began to grip both sides. To quote Winston Churchill, 'an iron curtain' descended across the European continent, 'from Stettin in the Baltic to Trieste in the Adriatic'. But apart from the differing ideologies, what were the drivers behind this disharmony?

In the Pacific, the last Theatre of Operations to cease fighting, WWII came to an end on 15 August 1945, after the United States heralded the beginning of a new era of warfare, having dropped two atomic bombs on the Japanese cities of Hiroshima on 6 August and Nagasaki, three days later. Coupled with the Soviet invasion of Manchukuo on 9 August, these two missions (as appalling as they were), undoubtedly saved many thousands of lives on both sides, especially given the increasingly fanatical way the Japanese were fighting, as US forces moved ever closer to the mainland.

World War II had delivered suffering and carnage on an unprecedented scale; an estimated 70.8 million people lost their lives – three per cent of the world's population in 1940. Casualties suffered by the Soviet Union, during what they refer to as 'The Great Patriotic War', were enormous; 8.7 million military and 13.7 million civilians had been killed (over 30 per cent of all those killed in WWII). Such huge loss of life and the fact that the United States had demonstrated to the world its newly developed nuclear technology – and if necessary, a willingness to use it – surely stoked Stalin's deep-rooted paranoia and his determination that the Soviet Union would never again endure such slaughter. A visual manifestation of this was the radically changed appearance of the European geopolitical map. Former democratic nations in Eastern Europe 'liberated' from the Nazis now found themselves occupied by the Soviet Union, which set about creating a 'buffer zone' between the West and the Soviet ‘motherland’. The Soviet’s grip on these nations was tightened further in 1955, when they were co-opted into joining the so-called Warsaw Pact, thereby reinforcing the defence of the Soviet western flank. By 1947, it was already apparent that the West now faced a new, powerful adversary: its former ally, the Soviet Union. So began a 46-year stand-off between the two world superpowers that has come to be known as the Cold War.

Tensions between the two superpowers became further strained over the differing ways each proposed to manage post-war Europe – particularly the now-partitioned Germany. Stalin believed his interests and those of the communist cause would be better served if the German economy remained weak. However, in stark contrast and drawing upon lessons learned from mistakes made after World War I, US Secretary of State General George Marshall proposed that the United States provide $15 billion ($168 billion in 2023 money), in economic assistance to restore Europe’s infrastructure and thereby also strengthen its democratic foundations. Indeed, President Truman also offered a similar plan to the USSR, but Stalin refused and, to his disdain, the Economic Recovery Act (also known as the Marshall Plan) was signed off by President Truman on 3 April 1948.

Two months later, on 24 June 1948, following unfriendly elections in Berlin and Soviet efforts to further destabilize the German economy, Stalin ordered the blocking of all road and rail links used by the West to supply the city that lay about 100 miles inside Soviet occupied East Germany. The blockade cut off supplies to the sector’s two million residents, causing the Allies to respond by mounting what became known as the Berlin Airlift: an enormous, round-the-clock air-bridge lasting 11 months that ultimately broke the Soviet blockade. The seriousness of the Soviet action prompted the United States to redeploy Boeing B-29 Superfortress bombers (the same aircraft type that had dropped the two atom bombs on Japan) to Britain.

WHAT TARGETS?

Given the significant numerical superiority of Soviet land forces, compared to those of the West, together with a strong belief in US circles that air power had played a significant role in defeating the Nazis and Japanese, it is not surprising that American decision makers opted to create a large, nuclear-equipped, strategic bomber force to win any future war with the USSR. The importance of this vital, high-profile task was underlined in March 1946 by the creation of the US Air Force's Strategic Air Command (SAC – pronounced 'sack'), whose ultimate *raison d'être* was to execute the war plan.

However, this was a tall order as witnessed by the consistent requirement for more and more bombers and nuclear weapons in successive early SAC war plans, codenamed Broiler, Frolic, Offtackle and Dropshot. The latter, which was compiled after the USSR had detonated its first atomic bomb on 29 August 1949, called for an additional 780 bombers (twice SAC's existing inventory), and it was estimated that over 450 atom bombs would be required during the first 30 days of war.

The first casualty of post-war peripheral 'ferret' missions was a US Navy PB4Y Privateer, similar to this one. Unarmed, it was shot down and crashed into the Baltic Sea, killing all ten crewmembers on board. (USAF)

On 8 April 1950, four La-11s from the 30th GvIAP intercepted and shot down Privateer *Turbulent Turtle* off the coast of Latvia. (Yefin Gordon)

On 17 December 1947, the USAF's first long-range, high-speed, high-altitude, jet-powered nuclear bomber, the Boeing B-47, completed its maiden flight. It was joined four years later by the mighty Boeing B-52. In total 2,000 B-47s and nearly 750 B-52s had been built by the time their production lines were closed in 1956 and 1960 respectively. Whilst the response of the United States military aviation industry was impressive, it begged the question: did the route planners and the crews who would be flying these aircraft, destined to create Armageddon, know where their targets were located? The answer, in the vast majority of cases, was a resounding NO!

To escape the Nazi Blitzkrieg, the Soviet leadership had implemented a radical policy involving the wholesale upheaval and relocation of its military bases and heavy industry to areas east of the Urals. Therefore, post-war Western maps and target intelligence covering the new threat were woefully inadequate. Returning German prisoners of war (POWs) were one useful source of western intelligence-gathering, but given the closed nature of Soviet society, the vastness of the country and the level of technology prevailing at the time, the only truly effective option left open to the West to access such sensitive information was to engage in a programme of long-range aerial reconnaissance. This would require a substantial number of aircraft and the task became even more critical in August 1949, following the Soviet Union's entry into the atom bomb era. This served to heighten US concerns, particularly about the possibility of a surprise

Soviet attack, mindful of the catastrophic intelligence failure that had led to the attack on Pearl Harbor, not ten years earlier. At this juncture, it is important to understand the differing types of intelligence, their procurement and application, since this underpins the very essence of the Blackbird programmes.

THE PRODUCT

As documented in USAF manual AFM 1-1, reconnaissance and surveillance constitute one of the nine basic operational missions of the USAF. It states that 'reconnaissance is a mission undertaken to obtain by visual observation or detection methods, information about the activities and resources of an enemy or potential enemy', and surveillance is 'the systematic observation of aerospace, surface, or subsurface areas, places, persons or things by visual, aural, electronic, photographic, or other-means'. The main difference between the two is specification and duration: surveillance systems collect information continuously while reconnaissance missions are directed towards localised or specific targets. In short, these two disciplines are the eyes and ears of the political and military establishment through which the necessary information is gained to support the decision-making process.

UNITED STATES AIR FORCE
461927

RB-29s conducted reconnaissance missions in the Far East as well as from the UK, and were particularly suited for long-range PHOTINT and ELINT missions. On 13 June 1952, 44-61810 *Demon Chasers*, belonging to the 91st SRS, was shot down and crashed into the Sea of Japan – all 12 crewmembers were killed. (USAF)

The collection of strategic reconnaissance is one of SAC's defined missions:

> The Mission – The Strategic Air Command will be prepared to conduct long range offensive operations in any part of the world either independently or in cooperation with land and Naval forces; to conduct maximum range reconnaissance over land or sea either independently or in cooperation with land and Naval forces; to provide combat units capable of intense and sustained combat operations employing the latest and most advanced weapons; to train units and personnel for the maintenance of the Strategic Forces in all parts of the world; to perform such special missions as the Commanding General, Army Air Forces may direct.

Basic doctrine is specific in defining strategic and tactical surveillance, reconnaissance operations and the relationship between them – the function being supported determines if it is strategic or tactical, not the command that performs the mission, nor the department or agency that funds the platform. It might be useful to clarify strategic intelligence.

Military planners were long familiar with the value of aerial intelligence to meet 'tactical' and 'operational' requirements. Tactical intelligence revealed, for example, where an artillery piece was located while operational intelligence indicated the amount of ammunition for that gun, a possible warning of an impending attack. Both tactical and operational intelligence remained vital during the Cold War, especially in targeting and war planning, but were of little direct value to senior civilian and military policy makers. Of greater interest to American policy makers was strategic intelligence. Sherman Kent, who headed the CIA's Board of National Estimates from 1952 through 1967, called strategic intelligence 'the knowledge *vital for national survival.*' It involved 'long-range speculation on the strength and intentions of other states,' as well as 'estimates of their probable responses to acts which we ourselves plan to initiate.' Considered the father of strategic intelligence and author of the defining work on the subject, Kent argued that strategic intelligence was 'indispensable to our welfare and security' and the cornerstone 'upon which our nation's foreign relations, in war and peace, must rest.'

Beginning with the Truman administration, US policy makers used strategic intelligence to achieve three major objectives crucial to the formulation of US national security policy. Most importantly the United States should 'develop and maintain an intelligence system' for early warning of Soviet aggression against the continental United States (and secondarily against Western Europe and Japan). Strategic intelligence would also provide US military planners, especially in SAC, with the defence capabilities of 'foreign countries, friendly and neutral as well as enemy' in the event of general war. Finally, strategic intelligence would forecast potential developments that would affect US national security and contribute to day-to-day planning and policy formulation concerning the USSR and its allies.

STRATEGIC OPERATIONS

Strategic surveillance and reconnaissance operations support the needs for national and strategic intelligence (they can also help to gap-fill the information requirements of tactical commanders). Strategic operations enable the assessment of the total capacity of a country to wage war and monitor the progress of a war, thereby providing information essential to:

The identification of targets for strategic and tactical attack.
Indications and warnings of hostile intent.
Damage assessment of enemy and friendly targets.
Determination of force structure.
Determination of research and development (R&D), requirements of warfighting systems.
Compliance/non-compliance with treaties and agreements.

TACTICAL OPERATIONS

Tactical surveillance and reconnaissance operations support the theatre and tactical field commander (they too might generate information that gap-fills both national and strategic intelligence requirements). Tactical systems provide indications of hostile intent and information from which intelligence is derived and cover:

Disposition, composition and movement of enemy forces.
Location of enemy lines of communication, installations and electronic emissions.
Post-strike damage.

Conditions in surface battle areas.
Weather and terrain.

The use to which the information is put determines the strategic or tactical nature of the collection operation.

During a mission, the assigned platform collects unevaluated information/material of every description. Intelligence is the product resulting from the collection, evaluation, analysis, integration and interpretation of all information concerning foreign countries. Strategic intelligence is required for the formation of policy and military plans at national and international levels, whereas tactical intelligence is required for the planning and conduct of tactical operations. The two differ only in the scope, point of view and level of employment.

Two MiG-15s flown by Capt Oleg Fedotov and Lt Ivan Proskoorin, of the 165th Air Division of the Naval Air Force, shot down *Demon Chasers*. (Yefin Gordon)

INTELLIGENCE COLLECTION DISCIPLINES

The two major intelligence collection disciplines are Imagery Intelligence (IMINT) and Signals Intelligence (SIGINT).

Imagery is obtained using photographic methods, which provide the basis of Photographic Intelligence (PHOTINT). Essential to the intelligence-gathering process are cloudless conditions. PHOTINT provides awareness, location, target numbers, etc. It won't provide the information required for a technical appraisal of the characteristics and capability of that target or of an enemy's intention to use it.

Similarly, radar imagery is collected and recorded to generate Radar Intelligence (RADINT). Its ability to be collected at night and through cloud is a clear advantage over PHOTINT. However, RADINT image resolution was greatly inferior to PHOTINT, particularly in the early Cold War years. Like PHOTINT, RADINT cannot provide information necessary to conduct a technical evaluation of a target, nor of intent.

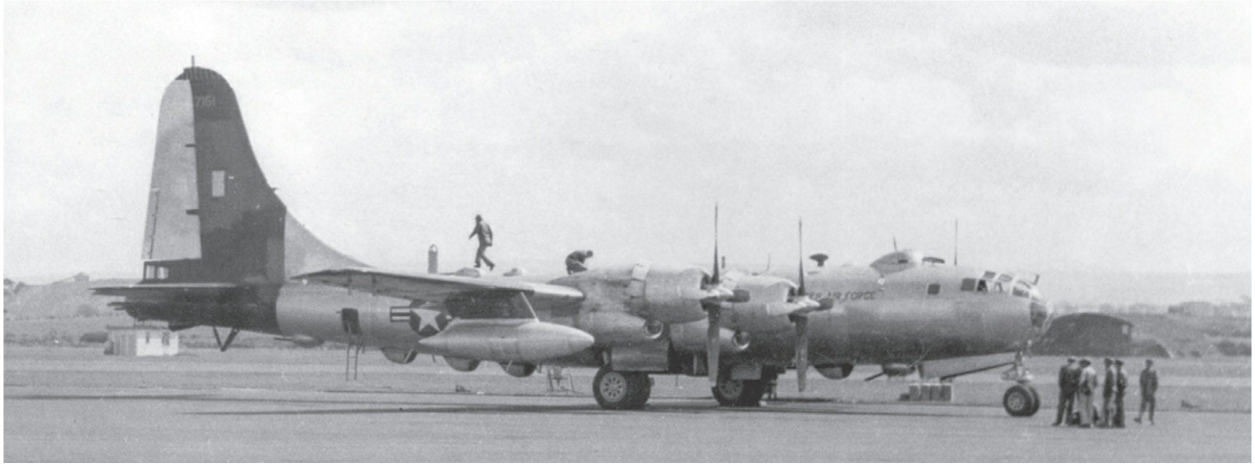
Signals Intelligence (SIGINT) is a category of intelligence information that covers all Communications Intelligence (COMINT), Electronics Intelligence (ELINT) and Telemetry Intelligence (TELINT).

COMINT is 'technical information derived from foreign communications by other than the intended recipients'. It can reveal the command-and-control structure of a potential enemy and intent.

ELINT is 'technical intelligence derived from foreign, electromagnetic radiation' emanating principally from radars. It enables the identification of an enemy's Electronic Order of Battle (EOB). Detection range is established, together with the location of specific radar types, permitting mission planners to devise bomber penetration routes that skirt such areas, thereby reducing enroute attrition and improving the probability of striking the allotted target. Additionally, by understanding the complex signal characteristics of specific radar types, it enables the development of Electronic Counter Measures (ECM), capable of jamming or deceiving such radar systems.

TELINT is 'technical and intelligence information derived from the intercept, processing and analysis of foreign telemetry'. This for example covers the technical guidance and control signals transmitted from an experimental missile to Soviet scientists as it returns through the Earth's atmosphere which, despite being encrypted, was routinely intercepted and decrypted by US scientists to learn the same details that were being transmitted to the missile's owners.

Reconnaissance missions collect a wide range of unevaluated information and material of every description. To gain an accurate insight into an enemy's capability and intent, utilized to formulate a plan or policy, it is therefore necessary that all of these intelligence collection disciplines are evaluated, analysed, interpreted and fused into a coherent intelligence report. Occasionally, one mission could be responsible for revealing a military assault on a neighbouring country, a previously unknown weapons system or piece of military hardware. However, in the vast majority of cases, information about a potential enemy's intent is achieved by conducting regular and systematic surveillance flights. These enable tracking and comparisons to be made by analysts and Photographic Interpreters (PIs), a process known as 'Indications and Warnings'. This is a time-tested methodology, enabling analysts to warn the military and national leadership of changes in an opponent's operational 'posture', which may indicate an escalation in dangerous or aggressive activity, thereby reducing the incidence of surprise, uncertainty and risk. It also alerts decision makers to developments that run counter to their planning assumptions. It is obviously essential that all types of information and intelligence is delivered to the appropriate decision maker, in the proper form and in *time* to have an impact upon the decision-making process.



Operated by the 55th SRW, RB-50Gs were an integral part of SAC's ELINT-gathering programme. 47-0161 *Caribbean Queen* is seen here having diverted into Prestwick with a mechanical problem. Not so fortunate was RB-50G, 47-0145, which was shot down during a 'ferret' mission on 23 July 1953 by two MiG-15bis off Gamov Bight, near Vladivostok. It crashed into the Sea of Japan and only one of its 17 crewmembers survived. (USAF)

COLLECTION AND CONTROL

Gathering peripheral reconnaissance along the borders of the Soviet Union helped plug some of the intelligence gaps – a task in itself not without risk. These contributed towards producing an accurate US National Intelligence

Estimate (NIE) of the Soviet Union's war fighting capability, but overflight produced an exponential amount of raw intelligence information. In retrospect, given the sensitivity of such flights and their possible ramifications (after all, the wilful violation of a sovereign state's airspace is contrary to international law), it seems extraordinary that a robust chain of command incorporating the highest levels of the executive to oversee and regulate such flights did not exist until 1950. Up until then, operational procedures and policies for peripheral and overflight reconnaissance missions of the USSR (maybe a half dozen) had been established by different regional commands, for example Pacific Far East Air Forces, US Air Forces Europe (USAFE) and Alaskan Air Command. It was USAF Chief of Staff, General Hoyt Vandenberg, who after April 1950 consolidated and co-ordinated all intelligence flights. Subsequently, the Departments of Defense and State agreed that the Air Force would 'maintain close co-ordination with the Department of State on the pattern and frequency of operations by [these] ferret aircraft'. 'Ferret' was the name given to platforms specifically tasked to gather SIGINT.

Given the size of the Soviet Union, an essential requirement of any intelligence-gathering platform was long range. Consequently, the USAF and US Navy initially conducted these reconnaissance or ferret flights using converted WWII-vintage bombers and patrol aircraft. Stripped of their heavy armour, it was hoped that they would be able to fly beyond the reach of Soviet interceptors.

As Allied reconnaissance operations continued, it was only a question of time before they provoked the inevitable and ultimate response. It occurred on 8 April 1950, and it involved a US Navy Consolidated PB4Y Privateer, Bureau of Aeronautics Number (BuNo) 59645, nicknamed *Turbulent Turtle* and operated by Detachment A of Maritime Patrol Squadron 26 (VP-26). The crew were undertaking a peripheral reconnaissance mission of the Soviet Navy's Baltic Fleet base of Libava, near Liepaja, Latvia, in international airspace, when it was intercepted and shot down by four Lavochkin La-11s, from the 30th GvIAP (Gvardeyskiy istrebitel'nyy aviapolk – Guards Fighter Regiment). The aircraft crashed into the sea and all ten crewmembers on board were killed.

The incident proved to be pivotal. While reporting the shootdown to President Truman and the Secretary of Defense, Chairman of the Joint Chief of Staff (JCS) General Omar Bradley informed them that both the Air Force and

Navy ‘have been codirecting’ ferret flights to obtain the ‘maximum amount of intelligence concerning foreign electronic development as a safeguard to national defense.’ Bradley went on to report that such operations had been ongoing ‘without a formal statement of policy, but on a basis of an informal working agreement between the Navy and the Air Force.’ In his meticulously researched book, *Spyflights and Overflights*, Dr Robert Hopkins III goes on to note that a month later, ‘Truman approved clearly defined operating procedures for future missions’, responding to a JCS recommendation that all reconnaissance flights were to be ‘armed and instructed to shoot in self-defence.’ This demonstrates that from this point on Truman and successive presidents knew about and approved of such reconnaissance flights. Truman also went on to approve a JCS recommendation to form the Special Electronic Airborne Search Project (SESP), to co-ordinate all US ferret operations and to resume all such flights around the world with immediate effect. This action made the JCS the agency responsible for the scheduling and conduct of these missions. However, at this stage there is no evidence to suggest that the president maintained any discretionary power for himself regarding sole approval authority for the missions. Whilst peripheral ferret missions of the Soviet Union were one matter, overflight was quite another.

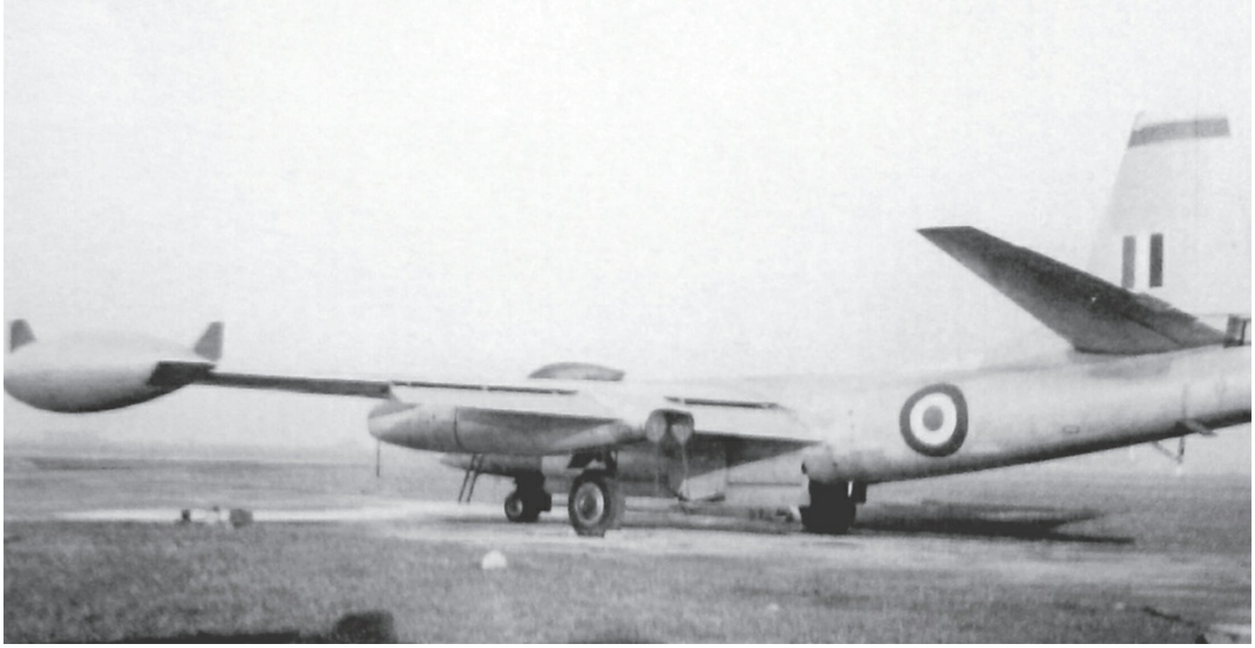
World destabilization continued and yet again, US intelligence services were caught off-guard when, at dawn on 25 June 1950, communist North Korea invaded its southern neighbour, sparking the Korean War. The conflict proved to both sides that the age of piston-engined bombers was over, as B-29s became dead ducks to MiG-15s. The age of the strategic jet bomber had arrived, with the introduction of powerful, new jet engines such as the Boeing B-47, followed in 1954 by the Tupolev Tu-16 (Badger-A).

Back in Europe, surveillance operations against the USSR continued. In February 1951, RB-45 Tornados from SAC’s 322nd, 323rd and 324th Strategic Reconnaissance Squadrons (SRSs), 91st Strategic Reconnaissance Wing (SRW), based at Lockbourne AFB, Ohio, began rotating through RAF Sculthorpe on three-month temporary duty (TDY) assignments. Later, four of these Tornados were ‘loaned’ to Great Britain and painted in RAF markings.

On the night of 21 March 1952 one of these aircraft, flown by an RAF crew, ventured into East Germany to gauge how the Soviets would react to such an incursion. Suitably encouraged, Allied planners put together an audacious mission codenamed *Ju Jitsu* that was implemented on the night of 17 April 1952. Three RB-45Cs in RAF colours and similarly crewed departed Sculthorpe, each heading for a separate air refuelling track: one was located over the North Sea, another over Denmark and a third south of Frankfurt.

Having finished tanking from US Air Force KB-29s, they climbed to 35,000ft and proceeded in total radio silence on routes that took them deep into the Soviet Union and were designed to overfly the maximum number of targets possible. One aircraft covered points in Estonia, Latvia, Lithuania, Poland and the former German province of East Prussia; another flew across Belorussia as far as Orel; and the third, piloted by Squadron Leader John Crampton, flew the longest and most southern route, crossing Ukraine and penetrating 'denied airspace' as far as Rostov on the Black Sea before returning safely back to Sculthorpe after a flight lasting 10 hours and 20 minutes. The operation was judged a success and a similar mission was flown, again by three 'RAF' RB-45s, on 28 April 1954. The RAF then exited its brief and highly classified relationship with the Tornado. The US 19th Tactical Reconnaissance Squadron (TRS) flew a similar three-ship mission over Warsaw Pact countries sometime later, after SAC had retired the aircraft from its inventory.

Perhaps not surprisingly, the Soviet Union was becoming increasingly sensitive to Western incursions into its airspace, and retaliated by pressing home a series of attacks on any aircraft suspected of violating its sovereignty. In April 1952, an Air France DC-4 was attacked and damaged in the Berlin corridor and, less than two months later, a Swedish Air Force C-47 was downed into the Baltic Sea, east of Gotland. Even a search-and-rescue PBY Catalina was attacked while looking for survivors – despite neither aircraft violating Soviet airspace. The Russians certainly meant business, as witnessed at 5:33pm local time on 13 June 1952, when RB-29A, 44-61810, assigned to the 91st SRS and operating out of Yokota AB, Japan, was shot down by two MiG-15s of the 165th Air Division of the Naval Air Force, stationed at Unashi, despite flying in international airspace. The entire 12-man crew aboard the reconnaissance aircraft were lost.



Prime Minister Churchill approved Operation *Ju Jitsu*, a three-aircraft deep penetration mission of the Soviet Union flown by RAF crews in SAC RB-45s, belonging to the 91st SRW, but carrying RAF markings. Based at RAF Sculthorpe, three different tracks were successfully completed on the night of the 17/18 April 1952. (USAF)

Virtually a repeat performance followed at 2:30pm local time on 7 October 1952, when RB-29A 44-61815, named *Sunbonnet King* and also from the 91st SRS, was destroyed by two Soviet La-11 fighters from the 368th Air Defence Fighter Aviation Regiment, while conducting a reconnaissance mission north-east of the island of Hokkaido, Japan, in international airspace. All eight crewmembers were killed.

It was not until 12 August 1952 that Secretary of Defense Louis Johnson briefed President Truman on a proposal to undertake the first US overflight of the Soviet Union. The plan, forwarded by SAC, had been approved by the JCS to cover the Chukotskii Peninsula of Siberia, in a bid to locate Soviet bomber bases. The mission, codenamed *Northern Run*, was approved by the president, 'subject to a full discussion with appropriate officials in the State Department and their concurrence.' The next day, Commander-in-Chief, SAC, General Curtis LeMay, received notification that Project Number 52 AFR-18 had been approved and that SAC should undertake the mission 'during the month of September at a date most likely to ensure its successful completion'. In the event, the flight, piloted by Col Don Hilman in a B-47B, departed and recovered back into Eielson Air Force Base (AFB), Alaska, on 15 October 1952.

As the RB-45's performance proved to be disappointing, they were transferred from SAC to Tactical Air Command (TAC) in 1953. However, anxious to acquire radar scope photography to aid SAC night bombing, four RB-45s were again sent to RAF Sculthorpe in March 1954. In a repeat of the April 1952 missions, on the night of 28/29 April 1954, three RB-54s were again flown by RAF crews, whilst 48-0031, seen here refuelling from a KB-29P, was flown over Murmansk by a SAC crew. (USAF)

The clearances required for the overflight to proceed demonstrate a high level of control and governance. They followed a clear procedural pattern, involving and requiring consent from many senior military and civilian officials, all of whom were clearly mindful of the impact that such a flight could have on US–Soviet relations. Indeed, tight regulation of both peripheral and overflights of the Soviet Union clearly demonstrates that SAC and its boss, General Le May, did not have a warmonger intent on provoking a third world war – despite what some conspiracy theorists and Hollywood film makers might prefer to think. As the Cold War continued, the process by which these vital flights were approved became even more tightly controlled – a reflection of the seriousness and sensitivity of the mission and the value and scarcity of these aircraft and their highly professional crews.

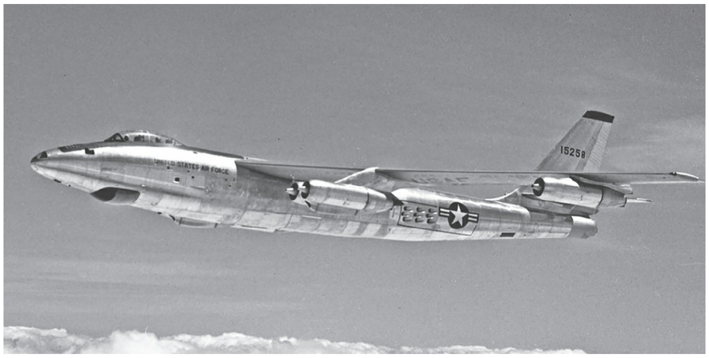
INNOVATION

The effort to identify alternative methods of securing reconnaissance of the Soviet Union, beyond the use of converted bombers, began in 1951 as a spin-off of Project Lincoln at the Massachusetts Institute of Technology (MIT). The Lincoln Laboratory initially focused on improving the nation's air defence system through advanced electronics, but this remit broadened when the Air Force required assistance that would enable SAC to develop innovative ways of procuring target information from behind the Iron Curtain.

As a result, the Air Force's Deputy Chief of Staff for Development, Major General Gordon P. Saville, recruited 14 reconnaissance experts into a central study group. The Boston-based group acquired its 'Beacon Hill' codename from the headquarters within which it was based, a nondescript room located above a secretarial school on Beacon Hill, in Cambridge, Massachusetts. It was chaired by Kodak physicist Carl Overhage, and first assembled in May 1951. Its members included physics Nobel Laureate Dr Edward Purcell and Dr James Baker (both from Harvard), Saville Davis from the Christian Science Monitor, Allen F. Donovan from the Cornell Aeronautical Laboratory, Peter Goldmark from Columbia Broadcasting System Laboratories, Dr Edwin Land, founder of the Polaroid Corporation, Stewart Miller of Bell Laboratories, Richard Perkin of Perkin-Elmer Co., and Dr Louis Ridenour, chairman of the scientific advisory board to the chief of staff, United States Air Force. Wright Air Development Center (WADC) sent Lieutenant Colonel Richard Leghorn along to serve as its liaison officer.

The Boeing B-47 established both a technological and numerical superiority over Soviet bombing capability – increased still further with the arrival of B-52s. Despite this, the US media and some congressmen went into a tail-spin with the arrival of the Mya M-4 (Bison A), declaring a 'Bomber Gap' in favour of the Soviet Union. (Yefim Gordon)

Fitted with more fuel-efficient engines, the Mya 3MD (Bison B) was superior to its earlier stablemate in terms of range. However, it was the turbo-prop propelled Tupolev Tu-95 (Bear) that would prove to be the Soviet's mainstay long-range strategic bomber. (Yefim Gordon)

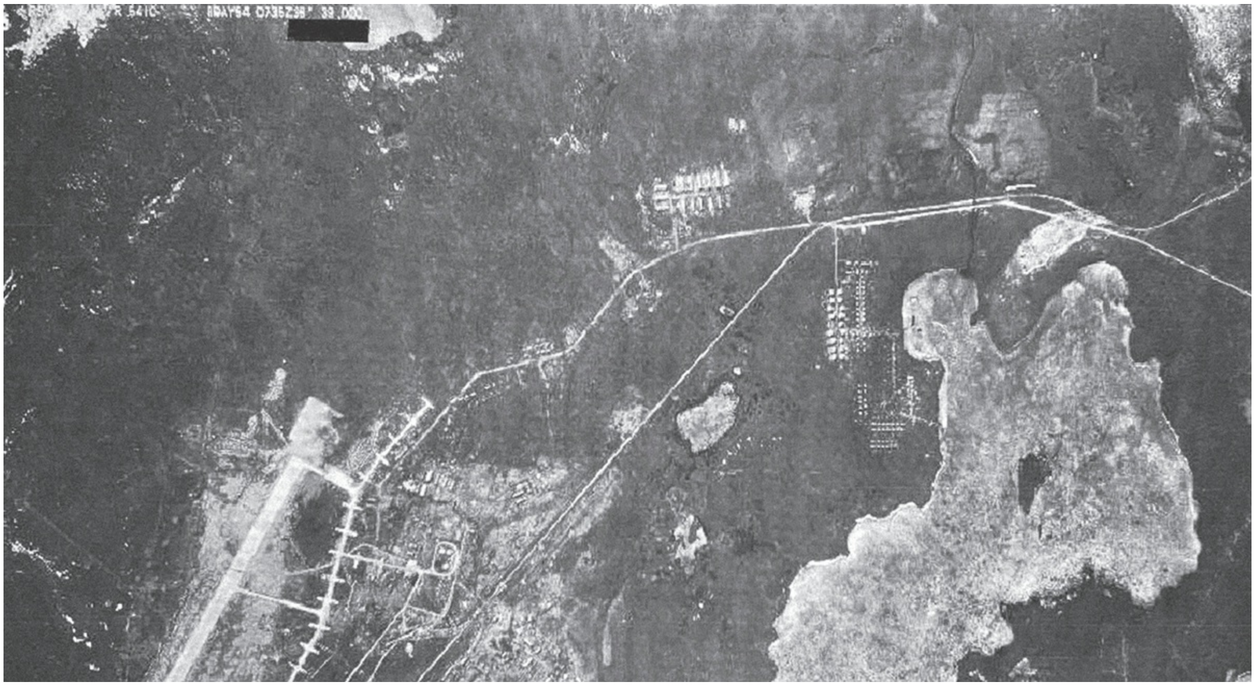


As part of Operation *Green Garter*, eight RB-47Es from the 91st SRW based at Lockbourne AFB, deployed to RAF Fairford. On 8 May 1954, one of these aircraft flown by Major Hal Austin, conducted a PHOTINT mission over Murmansk and Arkhangelsk in search of Soviet bombers as evidence of the 'Bomber Gap'. (USAF via Tony Landis)

On 15 June 1952, the group submitted its 14-chapter report to the Air Force. It advocated radical approaches to obtaining the information urgently required by the US intelligence community, in order to compose robust and accurate NIEs, and covered covert radar, radio and photographic surveillance. The report also examined the use of passive infrared and microwave reconnaissance, together with the development of advanced reconnaissance vehicles. One of its key recommendations called specifically for the development of high-altitude reconnaissance aircraft.

The idea of a purpose-built, reconnaissance-gathering aircraft was a concept being contemplated by US Air Force Maj John Seaberg, an engine specialist serving as assistant chief in the New Developments Office, Bombardment Branch, at Wright Field, near Dayton, Ohio. He proposed mating an aircraft with an extremely efficient high-aspect-ratio wing to the new generation of turbojet engines currently under development. Such a union should, he believed, create a platform able to cruise at altitudes far in excess of any other aircraft then in service. Spurred on by his new boss, William Lamar, Seaberg had by March 1953 created a formal specification, requiring the aircraft to cruise at an altitude of 70,000ft and to possess a range of 1,500nm while carrying a camera payload weight of up to 700lb. Furthermore, he proposed that the new aircraft should be in service by 1956.

Prompted by the Beacon Hill report, the USAF formally requested design studies for a specialized reconnaissance aircraft on 1 July 1953, based on the specification that Lamar and Seaberg had developed at Wright Field. These initial proposals were subsequently released to just three of the smaller aircraft manufacturing companies – another idea promoted by Seaberg – his rationale being that since large-scale production was not envisioned, the project would receive a much higher priority than if placed with the big players.



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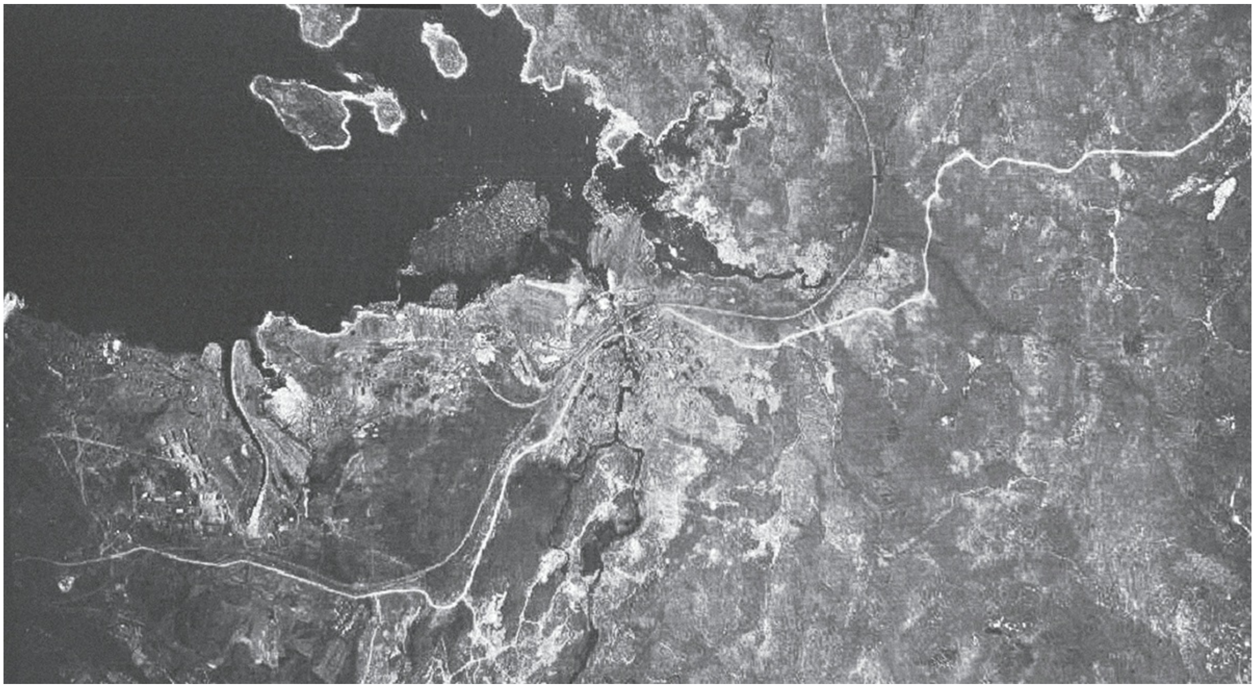
An image of a Soviet MiG base near Kandalaksa, south of Murmansk, taken by Major Hal Austin's crew, whilst overflying at 39,000ft (see annotation at top of image). (USAF via Tony Landis)

Consequently, Bell and Fairchild were requested to submit proposals for the design and construction of a totally new aircraft. Martin, however, was asked to produce a stopgap by applying improvements to its B-57 (a design built under licence from the British English Electric Company). During July 1953, six-month study contracts were agreed with each company and the project, now identified as MX-2147, was given the classified cryptonym 'Bald Eagle'.

On 20 November 1953, recently retired USAF Colonel Jack Carter, while working for Lockheed in its development planning office, handed a paper he had just completed to his boss, Gene Root. Both men had previously worked at the Pentagon in an office named USAF Development and Advanced Planning (AFDAP), which set development and planning objectives for various missions. Carter's memo, entitled *Strategic Reconnaissance* and classified 'eyes only', outlined the urgent need for a new type of manned reconnaissance aircraft. It pulled no punches: the target was the Soviet Union and the aircraft he was proposing should be capable of overflying that country at extreme altitude – between 65,000 and 70,000ft. Carrying a reconnaissance package of up to 500lb, the design would need to be radical to save weight, with a load factor as low as 2.25g (the military norm was more akin to 7g). In addition, the single-seat, turbojet-powered aircraft should have a maximum indicated airspeed of just 225–250kt and, in a bid to save weight, there would be no landing gear – just a bogie for take-off and a skid upon which to land.

Both men realized that the ideal group to work on such an unconventional aircraft was also located at Lockheed, within a small, limited access department known as Advanced Development Programs (ADP). This small manufacturing facility had come into being back in 1943, following Lockheed's successful bid to build the United States' first jet fighter. It was headed up by aeronautical design genius Clarence L. 'Kelly' Johnson. He recruited the finest engineers from the Burbank facility and put them to work in an area isolated and secure from the rest of the plant, building the XP-80 Shooting Star in just 143 days. The high level of secrecy surrounding the facility's activities, together with its position – adjacent to the unit's awful-smelling plastics manufacturing plant – caused Ervin Culver, a talented engineer on Kelly's team (who later invented the rigid rotor system for helicopters), constantly to answer the telephone using the name 'Skunk Works' after a location in a popular war-time comic strip written by Al Capp. The name stuck.



Another image taken on 8 May 1954, showing a large factory complex, again near Kandalaksa. Austin was extremely lucky to recover his aircraft safely back at RAF Brize Norton. (USAF via Tony Landis)

Once the initiative had been handed to Kelly Johnson, he realized that the reconnaissance requirement outlined by Carter could be met by modifying the fuselage of an F-104 Starfighter (an aircraft he and his team of Skunk Works engineers had just designed) and marrying it to a new high-aspect, low-thickness ratio wing. By 5 March 1954, Johnson and his small team had designed the CL-282, powered by a General Electric J73 turbojet and likely to reach 73,000ft at the end of its cruise climb from 65,000ft, to have a radius of action of 1,400nm and a payload of 600lb.

By January 1954, Bell, Fairchild and Martin had completed their studies and submitted them to Wright Field for evaluation. Apart from all three companies nominating the new Pratt & Whitney J57 axial-flow turbojet engine (with high-altitude modifications, its full designation would become J57-P-37), the designs varied considerably. As requested, Martin's proposed Model 294 was a 'big wing' version of the B-57. Bell's Model 67 was a frail-looking twin-engined craft, while the single-engined Fairchild M-195 featured an over-the-fuselage intake and a stub-boom mounting for vertical and horizontal tail surfaces.

Austin's RB-47E was attacked repeatedly by Soviet MiG-17 Frescoes. Prior to the mission, the crew were briefed that there were only much less capable MiG-15s in the area. (Yefim Gordon)

By March 1954, the Air Force engineers at WADC had nominated Martin's B-57D as the interim design, while the Bell proposal was felt to be the more suitable long-term design, not least because the team could not bring themselves to approve Fairchild's single-engine concept for such a mission. In April, Seaberg briefed all three designs to commanders at Air Research and Development Command (ARDC) in Baltimore, and SAC. This was followed a month later by yet another briefing, this time to Air Force Headquarters in Washington DC. Shortly afterwards, Seaberg received approval to proceed with the B-57D. Consequently, a list of B-57 modifications was sent to ARDC headquarters to enable urgent Air Force intelligence requirements in Europe to be met. Tentative approval was also obtained for the Bell Model 67 design.

Meanwhile, Johnson had sent his CL-282 design to Colonel Bernie Schriever at the Pentagon in early March 1954, as an unsolicited proposal. Schriever was extremely interested and requested a specific proposal from the Skunk Works boss. A month later Johnson was in the Pentagon promising to take complete responsibility for the programme, including production and field support of 30 aircraft. However, four Air Force generals present at the meeting (including Lieutenant General Donald Putt, the outgoing commander of ARDC) were less than enthusiastic. In early June 1954, HQ USAF wrote to Johnson rejecting his CL-282 design on the basis that it was too radical, was single-engined and that they had already committed to other proposals. Such an unequivocal rejection could easily have spelled the end of the line for the Skunk Works proposal were it not for a small group of high-powered individuals serving on various highly influential government advisory boards.

In October 1954, the Office of Defense Mobilization's (ODM's) Surprise Attack Committee (the ODM was an independent agency of the US government whose function was to plan, coordinate, direct and control all wartime federal government mobilization activities), established the Technological Capabilities Panel (TCP) under the chairmanship of Dr James Killian, president of MIT. As an offshoot of Eisenhower's own Science Advisory Committee, TCP members worked in the Executive Office and reported directly to him. Killian subdivided his panels' work into three projects.

Project One focused on offensive capabilities, Project Two on the application of technologies to defence, and Project Three on intelligence. Killian invited Edwin Land (who had sat on the Beacon Hill group), onto the steering group committee and asked him to chair the TCP's Project Three. Land then selected his project's membership, which fluctuated over the course of the coming years but included many that had served on previous advisory bodies for overhead reconnaissance. The original panel consisted of Allan Latham (from Polaroid), lens designer Dr Jim Baker and Ed Purcell (both from Harvard), chemist Joseph Kennedy from Washington University and John Tukey of Princeton and Bell Telephone.

Other key individuals also helped shape US airborne reconnaissance policy, including Trevor Gardner. Personally appointed by Eisenhower as Assistant Secretary of the Air Force for R&D, Gardner had also served on the Beacon Hill group; he had attended the Pentagon meeting during which Johnson had presented his CL-282 design and was impressed. Another was Philip Strong, a leading Central Intelligence Agency (CIA) analyst and the operations chief within the Office of Scientific Intelligence (OSI) of the CIA.

U.S. AIR FORCE
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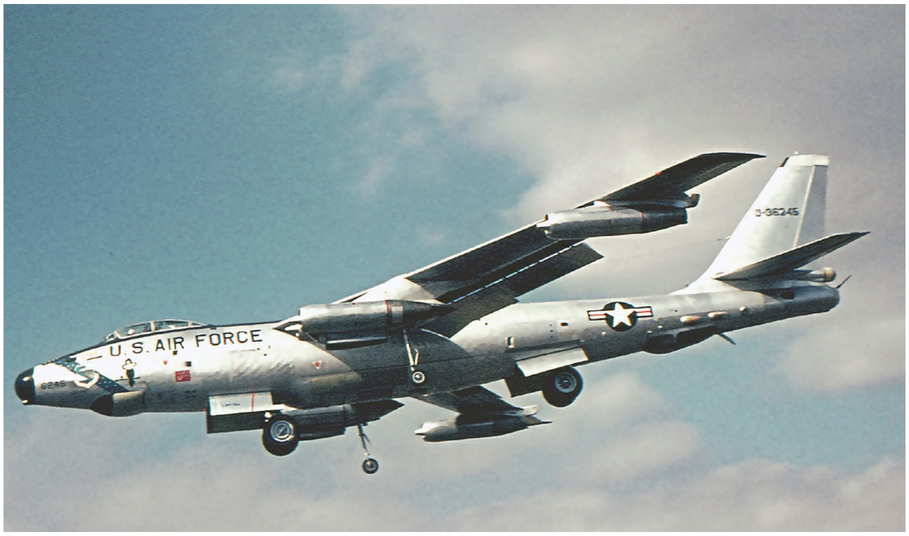
Between April and May 1956, Operation *Home Run* saw a massive series of overflight sorties flown to virtually all northern parts of the Soviet Union. Deployed to Thule AB, Greenland, the operation consisted of RB-47E PHOTINT aircraft from the 10th SRS, 26th SRW, from Lockbourne AFB. Four RB-47H – two each from the 343rd SRS and 38th SRS, 55th SRW, from Forbes AFB – gathered ELINT in response to the PHOTINT aircraft. Pictured is RB-47H, 53-4296, one of the 55th SRW birds; RB-47E 52-0719 is on the left. (USAF)

ADVANCED
DEVELOPMENT
PROJECTS
LOCKHE
SKUNK

Aeronautical engineering genius and Skunk Works boss Clarence L. 'Kelly' Johnson provided a radical step change in reconnaissance aircraft design with his Lockheed U-2. (Lockheed Martin)



Operated by the 55th SRW, ERB-47 H, 53-6245 was one of just three built specifically to collect more specialized ELINT signals, a task requiring two additional crewmembers known as Ravens. This particular aircraft was the first of its type to be deployed overseas and arrived at RAF Mildenhall on 23 January 1958. Note the stylized Raven below the cockpit, aft of the SAC emblem and banner. (USAF)

While serving on an Intelligence Systems Panel (ISP), which was part of the USAF's Scientific Advisory Board, Land and Strong were made aware of the

CL-282 and Bald Eagle designs. By late October 1954, Land's group had not only concluded that the CL-282 must be built, but had made the equally radical decision that the military should not 'engage directly in extensive overflight' and that such a task was more suited to the CIA, which 'as a civilian organisation [could] undertake (with the Air Force's assistance) a covert programme of selected flights'. However, when Land and Gardner went to see Director of Central Intelligence (DCI) Allen Dulles, he was less than impressed with their proposal. The DCI saw the 'Agency' as an espionage and analysis operation, and this proposal stretched way beyond such a remit. But when Land and Killian went to see Eisenhower shortly afterwards, they were heartened when, after some tough questioning, he endorsed the Land Panel's approach. Having served with distinction as a former army five-star general and Supreme Allied Commander Europe, Eisenhower was acutely aware of the political implications of directly linking such overflights to the military should an incident occur and the pilot be captured by the Soviets.

A letter from the TCP to DCI Dulles, dated 5 November 1954, recommended that the CIA establish a programme of photo-reconnaissance flights over the USSR with the assistance of the Air Force. In a subsequent meeting, held on 19 November in the office of the Secretary of the Air Force, Harold Talbott, the CIA and USAF agreed to pursue the TCP's proposal on a joint basis. This was followed up four days later by a memorandum signed by members of the Intelligence Advisory Committee (IAC), in support of the photo-reconnaissance programme.

On 18 November Lt Gen Donald Putt, who had moved from ARDC to become Deputy Chief of Staff for Development, brought John Seaberg to the Pentagon from Wright Field to brief the TCP scientists on the USAF perspective. Seaberg grudgingly conceded that the Lockheed design was 'aerodynamically close' to the Bell and Fairchild designs that he had sponsored. But he insisted that the J73 engine 'would not be good enough to do the job in Kelly's airplane'.

Summoned by Trevor Gardner, Kelly Johnson arrived the next day to meet Lt Gen Putt in the presence of Land's group. Johnson soon dispelled any lingering doubts about his design that the scientists may have had, although he did reluctantly agree to re-engine his C-282 with the Pratt & Whitney J57 and rethink the lack of landing gear.

AQUATONE

The Killian Committee's decision to back the refined CL-282 proposal was communicated to Secretary of Defence Charles Wilson and Dulles. On 24 November, a meeting was held at the White House with President Eisenhower to present and seek authorization for the CL-282 proposal, and request funds to produce 20 aircraft at a total cost of $35 million. This was duly sanctioned.

That same day, Kelly received a phone call giving him the go-ahead for the project, which was accorded the classified cryptonym 'Aquatone' (during the Agency's association with the U-2, which finally ended on 30 July 1967, the cryptonym changed on two occasions in order to preserve security when this was believed to have been compromised. It became 'Chalice' on 1 April 1958 and 'Idealist' on 15 May 1960, following the U-2/Frank Powers shootdown). Within days the Skunk Works had by default become a full-scale, advanced-design engineering and production facility.

The requirement for absolute secrecy meant that in the years ahead, the Skunk Works team was assured a high degree of autonomy from the rest of the Lockheed Corporation; additionally, the high level of specialized support required to run the programme, coupled with the lack of CIA expertise in this field, ensured Lockheed's participation in the programme for the life of the aircraft. In one step, a series of precedents had been set for future aircraft programmes.

On 1 February 1954, Richard Bissell Jr (a brilliant economist who lectured at Yale and MIT), was named Director for Planning and Coordination by DCI Allen Dulles. In order to preserve the secrecy that Eisenhower and Dulles insisted upon, Bissell suggested locating Aquatone in a 'stand-alone organization rather than as part of an existing CIA directorate'. The resulting Development Projects Staff (DPS) was the only CIA component with its own communications office and 'operational cable traffic'. Headquarters for the project was moved to a suite of offices in the Matomic Building at 1717 H Street, Washington DC.

Later that year, in response to congressional criticism of the CIA, the Hoover Commission established a Special Study Group, chaired by Lt Gen James Doolittle, to investigate the agency's covert activities. When it reported back on 30 September, it expressed the belief that every known technique should be used, and new ones developed, to increase US intelligence by high-altitude photographic reconnaissance and other means.

The team Kelly recruited to design and build the new reconnaissance aircraft included Dick Boehme (project engineer), Art Viereck (head of manufacturing), Ed Baldwin and some 50 other key engineers. Kelly nominated Tony LeVier (chief test pilot on the XF-104) to be the project's chief test pilot and his first task was to find a secret site from which to conduct flight tests. Edwards and Palmdale were initially considered, but soon discounted by the US government, which deemed them too visually accessible to the public.

In response, LeVier and Dorsey Kammerer, a Skunk Works' logistics specialist, borrowed the company Beech Bonanza and conducted a two-week aerial survey of remote desert areas in southern California and Nevada. They then submitted a short list of possible options; none appealed to Bissell or Col Ozzie Ritland, the USAF's liaison officer to the U-2's DPS. To settle the issue, in mid-April 1955 LeVier used the Bonanza to fly Johnson, Bissell and Ritland up to some likely sites near the Nevada nuclear test range. Ritland, a pilot who was once assigned to the B-29 test squadron that had dropped nuclear weapons at the range, directed LeVier towards an old WWII airfield that he remembered just to the north of the test range and adjacent to Groom Dry Lake. They landed on the lakebed and, according to Ritland, 'within 30 seconds we knew it was *the* place'.

In early May 1955, the DPS issued contracts worth $800,000 for construction work at the secret site. It was to consist of a 5,000ft runway, control tower, mess hall and three hangars. Johnson, with generous amounts of irony, euphemistically referred to this parched desert location as Paradise Ranch, soon inevitably shortened to 'The Ranch'.

On 7 May 1956, an elaborate cover story, devised to mask the true purpose of the U-2 programme, was issued to the press in the name of Dr Hugh Dryden, director of the National Advisory Committee for Aeronautics (NACA), the predecessor of the National Aeronautics and Space Administration (NASA). It announced that the first U-2 aircraft were participating in an upper atmosphere research programme and 'flying from Watertown Strip in Southern Nevada'. Watertown had become the 'official' title for The Ranch, the CIA naming it after the town in upstate New York in which Allen Dulles was born.

Part of the vast Nevada test site had been a WWII gunnery range and a walk across the lakebed revealed countless spent 50-cal rounds, shell cases and links.

Divided into many areas, the site fell within the boundaries of the main Atomic Energy Commission (AEC) nuclear test site. Therefore, the area had to be cleared, fenced off and a restricted airspace zone established. Within three months, under the auspices of Richard Bissell, a large team of AEC construction crews was working around the clock to transform the site into a basic test facility.

To ensure that 'Kelly's Angel' (as the high-altitude design was being referred to by some in the Skunk Works) kept ahead of its rival the Bell 67 (now officially designated X-16 by the Air Force as a cover), Johnson promised that his design would be airborne no less than eight months after first metal was cut. The initial batch of 20 aircraft was built at the Burbank plant; thereafter further production was moved to Oildale, near Bakersfield, California.

On 15 March 1955, wind tunnel testing had been successfully completed and on 21 May, the fuselage of 'Article 341', the prototype, was removed from its jig. On 20 July, the completed aircraft was handed over for final checks. The next day it was disassembled and placed into loading carts. At daybreak on 24 July, Article 341 was moved into an Air Force C-124 and flown to Watertown. There it was reassembled in the semi-completed hangars, and three days later static engine runs were initiated.

NACA
NACA 308

Known initially as Project Aquatone, the CIA-run U-2 programme provided answers to many intelligence questions regarding the Soviet Union's industrial and military capability. Its cover story, high altitude weather research run by the National Advisory Committee for Aeronautics (NACA – which became NASA in 1958), was underpinned by its early markings – as seen here at Watertown Strip – Area 51. (Lockheed Martin)

After taxi tests – the third of which culminated in the aircraft inadvertently getting airborne to a height of 35ft – the scheduled first flight took place at 3:55pm on 4 August 1955. Witnessed by several key Skunk Works and Agency people, Tony LeVier (using the call sign ANGEL 1) was chased by a Lockheed-operated C-47, flown by company test pilot Bob Matye and accompanied by Kelly Johnson (Matye became the second pilot to fly Article 341).

It was during these early stages of the flight test programme that the aircraft was officially designated U-2, 'U' being the USAF prefix used to designate utility aircraft, another deception designed to hide the aircraft's true mission. Bell's X-16 had also been progressing well, with construction getting under way in September 1954 and its first flight scheduled for early 1956. However, with the Agency, not the Air Force, now responsible for high-altitude reconnaissance, the X-16's *raison d'être* had disappeared. Consequently, two months after the U-2 took to the air, a decision was made to terminate the X-16 contract. It was a bitter blow for Bell and one that had serious financial implications for the company for several years.

By 1 September 1955, Tony LeVier had completed 20 flights in the U-2, but left Project Aquatone for Burbank, having been promoted to Director of Flying. Future test flight planning became the responsibility of Ernie Joiner, and Bob Matye and Ray Goadey undertook the flying.

The first of six RB-57s was delivered to SAC under Project Black Knight in March 1956. The aircraft went to the 4025th SRS, 4080th SRW at Turner AFB, Georgia, which conducted its first operational deployment under Operation *Sea Lion* overflying Vladivostok in December (the last US *military* overflight of the USSR) just four months after activation. Most of these early operations were electronic intelligence/signals intelligence (ELINT/SIGINT) missions, flown from operating locations (OLs) at Yokota AB, Japan and briefly Eielson AFB, Alaska.

Highly classified, these ferret sorties employed specialist equipment designated Model 320 or Semi-Automatic Ferret Equipment (SAFE), which had been tested during 1956 and 1957 under the Blue Tail Fly project; thereafter it was declared operational and deployed on board the RB-57s. In addition, the unit conducted high-altitude sampling, during which particles were collected from the upper atmosphere following nuclear tests undertaken by China and the Soviet Union. This enabled scientists to ascertain weapon characteristics, including yield and efficiency. On the world stage, events were about to ratchet up a notch.

THE GAPS APPEAR

During the 1955 May Day parade in Moscow, the Soviet Union decided to unveil its long-range strategic jet bomber. The prototype Myasishchev Mya-4 (codenamed 'Bison A' by NATO) completed a flyby flanked by four Mikoyan MiG-17 fighters. More followed on 23 June 1956 when, during a visit to the Soviet Union, USAF Chief of Staff General Twining and his entourage reported seeing 28 of the new large bombers. In fact, it was a masterful piece of Soviet subterfuge. Flying past the review podium in small formations, the bombers turned when out of sight of their distinguished visitors and made multiple passes. The ruse worked, but backfired when, due to a lack of information, Western intelligence agencies assumed that the size of this new Soviet bomber force was much larger than it was, thereby resulting in the US building more bombers than they otherwise would. In fact, only 34 Mya-4s and 74 of the more capable Bison Bs were built.

Its appearance also reinforced the decision to develop and produce the U-2, precisely to obtain reliable intelligence about true Soviet military capability. But when existence of the new bomber was seized upon by the US media and congressional hawks, wild claims circulated that the Soviet bomber force was likely to number 800 by 1960, thereby exceeding US B-47 and B-52 production substantially. The cry 'Bomber Gap' was thus born, enabling the USAF to negotiate a larger slice of the defence budget to increase the acquisition of US bombers.

The U-2 was able to help disprove the existence of a 'Bomber Gap' or 'Missile Gap'. Key to its operational success was the ability to fly at extreme altitudes, which required the pilot to wear a partial pressure suit, as seen here. Pictured is Francis Gary Powers, who became synonymous with the U-2 overflight programme after he was shot down by a Soviet SA-2 Guideline surface-to-air missile on 1 May 1960. (Lockheed Martin)

In February 1957, the 4025th relocated from Turner to Laughlin AFB, Texas and one month later it received the last of 20 RB-57Ds ordered by the Air Force. For six months further air-sampling flights were conducted, this time from Eniwetok Proving Grounds in the Marshall Islands. Then, in early 1959, under Operation *Bordertown*, the unit deployed to Europe, where it continued to conduct air sampling and ELINT/SIGINT missions, before returning to Laughlin and being deactivated in mid-1959.

On 4 October 1957, the Soviet Union launched the world's first artificial satellite – *Sputnik*. In and of itself, *Sputnik* was harmless, orbiting the Earth transmitting beeps as it went. Of concern to Western politicians and intelligence chiefs, however, was the Soviet R-7 *Semyorka* rocket, that had propelled the satellite into orbit. If required, surely the same rocket could be used to launch atomic weapons at targets in Europe and the United States. Thus, the term 'Missile Gap' was conceived, which stoked fears in the same way as those of a 'Bomber Gap'. The former sound-bite was being used relentlessly by US Democratic presidential candidate, Senator John F. Kennedy, to emphasise how the Republican party were ‘soft on defense’ during his 1960 presidential campaign. A position no doubt welcomed by US military leaders.

CAMERAS AND CREWS

The mission payload of early-model U-2s was held in a cavernous pressurized area behind the cockpit, known as the Q-bay. The acquisition of PHOTINT was to be the aircraft’s primary mission and Dr Jim Baker proved pivotal in the conceptualization of its camera systems. Three were worked up. Type A was primarily refurbished Air Force stock and a stopgap. Type C, with its 180in. focal-length lens, was overtaken by events, while Type B camera became Project Aquatone’s workhorse.

Using a 36-in. focal-length lens, its large-format film (18×18in.) was loaded onto two 6,500ft rolls. When the system was activated, the camera imaged onto two 9½in.-wide frames through a single lens, thereby providing very high-resolution, stereo coverage of the collection area with a 50–70 per cent overlap. Manufactured by the Hycon Corporation, the Type B camera system plus film weighed about 500lb. Also located in the Q-bay was a 35mm tracking camera. This scanned from horizon to horizon throughout the flight, providing the photographic interpreters (PIs) with an accurate ground track of the aircraft’s flight path.

Pilots recruited into Project Aquatone by the Agency came straight from the Air Force on a ‘suspended contract’; their ‘grey suit’ time during the period of ‘secondment’ counted as time served in the military. Having passed various interviews, conducted by mysterious civilians at insalubrious hotels, they then spent a week undergoing one of the most rigorous medicals ever devised, at the specialist Lovelace Clinic, Albuquerque, New Mexico. In all, about 25 pilots, in three intakes, were recruited into the Agency programme.

During the Geneva Summit on 21 July 1955, President Eisenhower had proposed that an ‘Open Skies’ plan be considered between the United States, the Soviet Union and other participating countries, wherein a limited number of annual reconnaissance overflights would be made in order to verify claims of declared force strengths. Surprised by the proposal, the Soviet delegation reacted favourably and agreed to confer with their Party Secretary, Nikita Khrushchev.

However, his paranoia and deep mistrust of the West conspired to ensure that he neither signed up to, nor rejected, the proposal. Such prevarication ensured that Open Skies failed one month later, when a vote was taken in the United Nations. By June 1956, the initial flight test and training objectives of Aquatone had been completed, and six pilots, together with ten U-2s, were readied for operational deployment. Operation *Overflight*, the contingency plan to Eisenhower's Open Skies proposal, was ready.

A major factor that had influenced Eisenhower in his decision to authorize *Overflight* was a US NIE issued while the U-2 was being developed. It noted that 'although the Soviets have made great strides in radar development', their standard S-band V-band early warning radar, nicknamed Token, 'had no capability above 60,000ft'. Token coverage was supplemented by two metric (VHF-band) air defence radars, P-3 and P-8, codenamed 'Dumbo' and 'Knife Rest' respectively, and believed to have similar capabilities. The NIE was correct as far as the P-3 and P-8 were concerned, since these could only provide bearing and range information.

However, the West knew nothing about the A-100 radar, which provided early warning for the SA-1 'Guild' (Soviet designation S-25), surface-to-air missile (SAM) systems located around Moscow. The SA-1 was a first-generation air defence system, employing the E-band radars for target acquisition and fire control and missile command guidance. It was very short-lived, and soon replaced by the far more capable SA-2 'Guideline' (S-75 Dvina). Alarmingly, the NIE estimate of Token's capability was soon proved wrong.

The list of Soviet targets for the U-2's camera package was by now huge, so much so that Bissell established a system of prioritizing them by organizing the so-called Ad-hoc Requirements Committee (ARC). A CIA staff officer chaired the committee and it was drawn from representatives of the three main armed services. The top priority targets were passed to Project HQ, where mission planners devised potential routes for U-2 flights. They knew that they had to cram as many targets as possible into each mission. Having read the detailed brief on Project Aquatone, Eisenhower told his staff secretary, Brigadier General Andrew Goodpaster, that he wanted all the vital targets covered as quickly as possible. The president also made it clear that he wanted the flights stopped if they could be tracked, as he was acutely aware of the political sensitivities.

In anticipation of Eisenhower's decision, two U-2s had been air freighted to

RAF Lakenheath, England, on 30 April 1956, where the first of three Agency detachments was formed under the entirely fictitious designation 1st Weather Reconnaissance Squadron, Provisional (WRSP-1). Within the 'inner circle' this was known as 'Detachment A' and consisted of Agency and Air Force personnel, and contracted civilians. However, on 16 May Prime Minister Anthony Eden wrote to President Eisenhower requesting a postponement of Det A's operations, following an embarrassing incident with the Soviet Union over an attempt by Royal Navy frogmen to covertly survey the cruiser *Ordzhonikdze* in Portsmouth harbour while it was carrying Nikita Khrushchev. No operational sorties were therefore flown from the UK and the unit redeployed to Wiesbaden, West Germany on 15 June. This new location was close to Camp King, the Agency's main West German intelligence-gathering facility.

On 20 June 1956, the first U-2 operational mission took place when Carl Overstreet departed Wiesbaden on Mission 2003. Using the A-2 camera system – the B became available later in the year – Overstreet flew over areas of East Germany, Czechoslovakia and Poland before recovering safely back at Det A. The undeveloped film and SIGINT tapes were unloaded and flown back to the US, where they were processed and examined two days later.

On 21 June, Bissell, Killian and Land travelled to the White House, where Goodpaster explained the president's thinking. Eisenhower was going to keep tight control of the flights, wanted frequent reports and, despite the CIA's assurances, remained worried that the flights might be detected. As decision time to launch the U-2 on Soviet overflights loomed ever closer, Eisenhower's anxiety grew, and on 2 July he told Goodpaster that he urgently needed to know whether the missions launched to overfly targets in the Soviet satellite countries had been picked up.

On 2 July, two U-2s left Wiesbaden in rapid succession. Mission 2009 flew south, covering Hungary and Bulgaria to the Black Sea, while Mission 2010 covered eastern Czechoslovakia, Hungary and into Romania, also reaching the Black Sea before turning back. Both aircraft safely landed back at Wiesbaden.

On 3 July 1956, before the post-flight analysis of the first three missions was complete, Eisenhower had Goodpaster tell Bissell that he had approved a 10-day slot for Soviet overflight missions, but that he was to be provided with interim reports on tracking and attempted interception.

No time was wasted, and since Wiesbaden was six hours ahead of

Washington, it was 6:00am on US Independence Day, 4 July, when Hervey Stockman took off on Mission 2013. He covered targets around Minsk and Leningrad, but peering through the aircraft's drift-sight he saw MiG fighters climbing in unsuccessful attempts to intercept the intruder. Contrary to all American hopes, the flight had been detected. Undeterred, Stockman continued his mission as planned, passing over suspected Soviet bomber bases in the Baltic States, before recovering into Wiesbaden following a flight lasting eight hours 45 minutes.

Following the successful completion of that first mission, Eisenhower had Goodpaster tell Dulles 'if we obtain any information or warning that any of the flights has been discovered or tracked, the operation should be suspended until he (the president), has an opportunity to consult on the matter with Secretary [of State John Foster] Dulles and Allen Dulles'. After being told this, Allen Dulles and Bissell went to the White House to clarify the message. They told Goodpaster that it would be at least 36 hours after each mission before they would receive the first reports of detection, tracking and attempted interception, and that it could be as long as several days or weeks. If they had to wait this long between each mission, they would not be able to follow the president's intention of covering as many targets as quickly as possible. Goodpaster told them that he understood that the president wanted the mission to 'go forward at the maximum rate until the first evidence of tracking was received'.

Although unable to operate in a high-threat environment, the U-2's endurance, adaptability, sensor packages and low operating costs have ensured it continues to make a vital contribution to intelligence gathering, nearly 70 years after its first flight. (Lockheed Martin)

On 5 July 1956, Article 347 was again airborne, this time with Carmen Vito at the controls, on U-2 Mission 2014, an overflight that encompassed the Soviet capital, Moscow. Again, the U-2 was detected. MiGs were sent to intercept the aircraft but they were unsuccessful.

Eisenhower was informed that the flights were being detected, though still imperfectly. Despite considering halting Aquatone, the president decided it could continue until more definitive information was available.

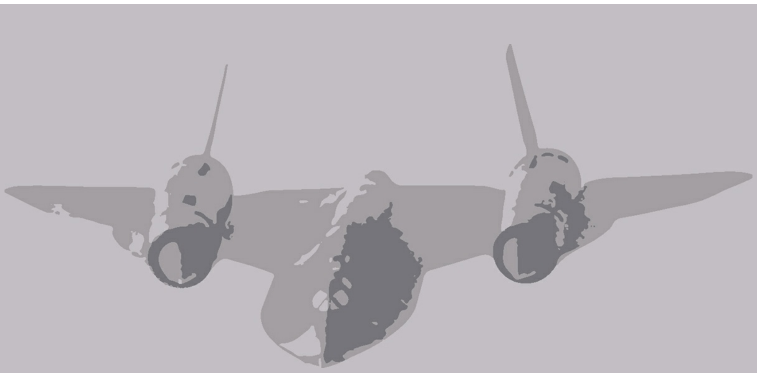
Back at Wiesbaden, bad weather had prevented further overflights and it wasn't until 9 July that two U-2s got airborne in quick succession. Marty Knutson flew Mission 2020 up the Baltic coast to Riga before turning to cover targets around Kaunas, Vilnius and Minsk, then returning to Det A via Warsaw. Meanwhile, Carl Overstreet took Mission 2021 over Ukraine as far as Kiev before returning to 'home plate' via southern Poland. While Overstreet was transiting Kiev, anti-aircraft artillery (AAA) put up a spirited but futile show of defiance that attracted plenty of attention, especially from Kiev's residents.

The next day, Glen Dunaway flew Mission 2024 all the way to Kerch on the eastern tip of the Crimea peninsula, returning via Sevastopol, Simferopol, Odessa and the satellite countries. Apart from what were fast becoming the usual attempted fighter intercepts far below, this fifth U-2 overflight mission was without incident.

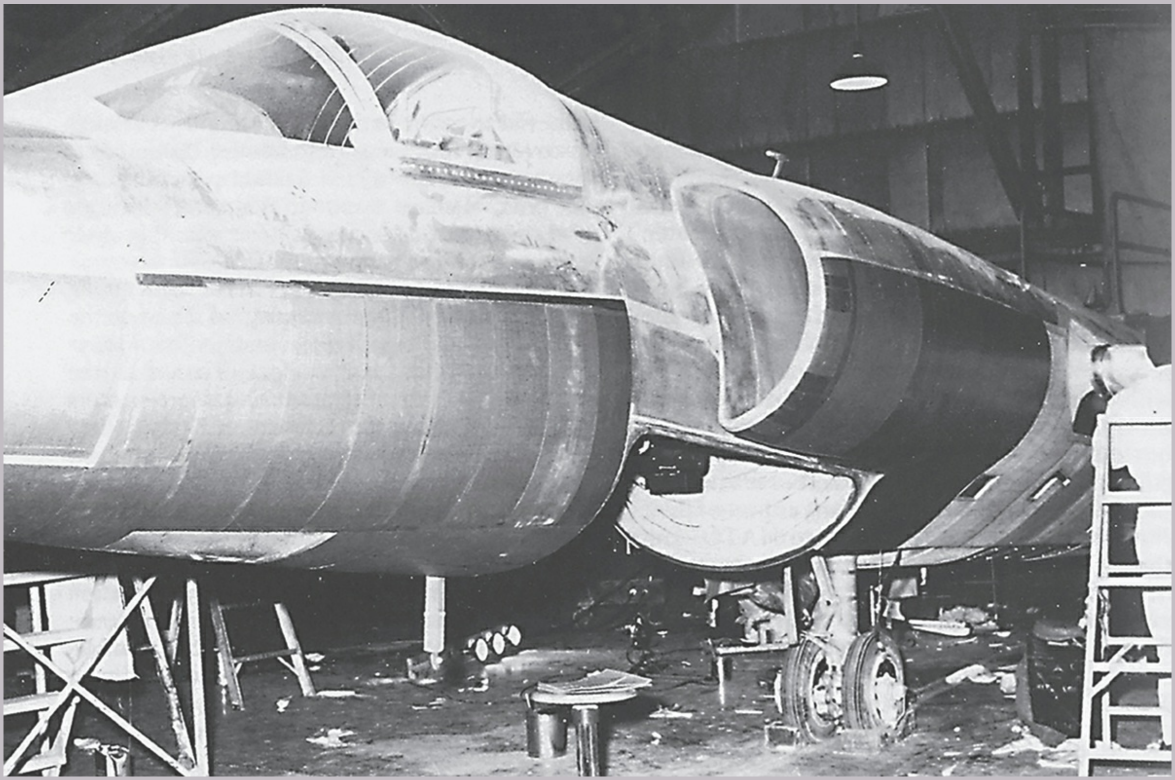
Early on 10 July 1956, Goodpaster informed Eisenhower about the meeting he had had with Dulles and Bissell a few days earlier, adding that there had been some indications of tracking. The president was not impressed and according to Goodpaster he seemed very close to stopping the overflights.

By now the Soviet 'diplomatic cage' had been well and truly rattled. Later that same day the USSR delivered a protest note about the previous days' flights to the US embassy in Moscow. It was clear that the Soviet air defence system had not only detected each flight, but had tracked them for considerable distances. After this was communicated to Eisenhower, as far as he was concerned the game was up: he believed that detection was almost as bad as interception and immediately suspended all U-2 overflights.

The president was extremely annoyed that assurances given by Bissell and others had proved false – they had told him that the flights would hardly be detected, let alone tracked. Eisenhower never again gave the CIA *carte blanche* for a series of U-2 overflights. When he eventually authorized the overflight programme to resume, it was on the basis of one clearance, one flight and he insisted on being briefed on all the details regarding routes, defences, etc. More often than not, permission was withheld. Ironically, CIA U-2 planners similarly implied to the president that in the event a U-2 crashed or was shot down over the Soviet Union, the pilot would not survive, a claim which they eventually came to regret (again, much to Ike's embarrassment).



CHAPTER 2:
RAINBOW AND GUSTO



A U-2 having radar-absorbent material (Echosorb) applied to its lower fuselage. (Lockheed Martin)

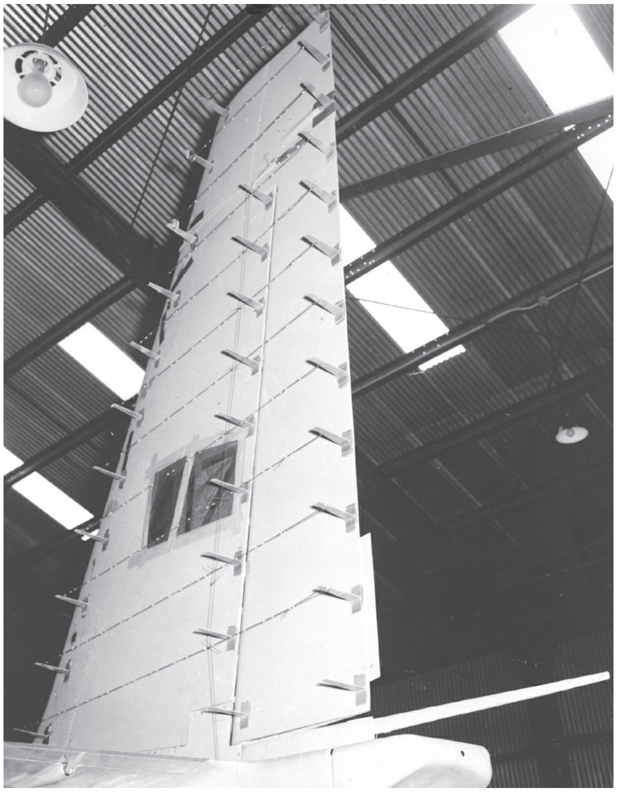
On 16 August 1956, Richard Bissell convened a meeting to explore initiatives that could be developed into solutions regarding the problem of the U-2 being detected by radar and thereby address Eisenhower's concerns. Kelly Johnson later wrote:

> Up to see Land, Purcell, Stew Miller with Herb and Dick [Herb Miller and Dick Bissell]. Worked till 1:30 and two bottles of Scotch. Up at 7:00 and we resumed – even Dick. By noon we had programme 'X' going. My biggest job now.

By midday, they had devised a programme that would explore various radar-cancelling devices and the project was accorded the classified cryptonym Rainbow. It was the first attempt to make an operational aircraft 'stealthy'. Land chaired the project and a small number of radar experts were recruited into the programme via Marshall Holloway, Director of the MIT Lincoln Laboratory, in Lexington, Massachusetts. Based in a secure building on the roof of the Lincoln lab (often referred to as the RadLab), it included Dr Frank Rodgers (associate head of the Radar Division).

A major problem facing the team was the broad band of frequencies that a U-2 would encounter during the course of a Soviet overflight. First it would need to remain invisible to long-range, low-frequency early warning radars operating within the V-band (65–86MHz). Then, having penetrated Soviet airspace, it would have to contend with high-frequency S-band (2–4GHz) and X-band (8–12GHz) target acquisition radars. Since a single broad-band solution (one that would counter all the frequencies) was not technically feasible, methods and materials would need to be developed to defeat the different radar systems.

To deceive S-band radars, the team came up with a radar absorbent material (RAM) treatment they called 'Wallpaper', which was applied to the underside of the aircraft's fuselage. It was a clever implementation of a Salisbury screen, working on the quarter wavelength principle. Just ¼in. thick and weighing 1oz/sqft, it consisted, from the inside out, of fibreglass, a honeycomb spacer, a graphite-impregnated layer, a protective layer for durability and a layer of paint.



In an attempt to hide the U-2 from Soviet radars operating in the metric (VHF) wavebands, wires were positioned at carefully measured distances on the aircraft's wings, fuselage and tail surfaces. (Lockheed Martin)

The graphite-impregnated layer was key, because its electronic properties caused it to behave as though it were much thicker. This meant that even though the coating was 1/16 of a wavelength in thickness, it acted as though it was a quarter of a wavelength. With the graphite layer effectively positioned a quarter of a wavelength from the aircraft's skin, it would reflect some of the incoming radar energy. The remaining energy would strike the U-2's actual surface and then be reflected, these 'emergent waves' cancelling out the graphite-reflected waves since they were 180° out of phase. It was also found that by cutting a small iris into the centre of each square of 'Wallpaper' it would also and reduce returns from X-band radars.

The greatest difficulty facing the Rainbow team was how to defeat the Soviets' early warning V-band radars with their 14ft wavelength. The RadLab, in conjunction with a small team of electronics engineers back at the Skunk Works, headed up by Luther Duncan 'LD' MacDonald and including Perry Reedy and physicist Ed Lovick, eventually developed two systems referred to as 'Trapeze' and ‘Wires’.

Trapeze featured copper-plated steel wires strung spanwise around the leading and trailing edges of the wings and tailplanes. Fibreglass wing and tailplane tip extensions supported the wires, as did intermediate chordwise fibreglass ‘fishing poles’. To adjust the impedance of the wires to form a slow wave structure, ferrite beads were strung on them at precise locations. Chordwise wires connected the spanwise wires to the wing leading and trailing edges, and ferrite beads were again to tune the frequency response. Trapeze formed a slow wave structure, which induced currents that suppressed the rhombic lobes otherwise generated by the U-2’s wing and tail planform.

The sides of the U-2’s fuselage generated a large reflection at some frequencies. To counter this, the team jointly developed Wires, a similar Heath Robinson contraption to Trapeze. A form of Salisbury screen was created by placing groups of ferrite beads at regular distances along long wires running along the fuselage, and across the tail fin. Each long wire behaved as though it were a series of separate wires, or dipoles, counteracting the radar signal.

With two U-2s dedicated to project Rainbow up at Watertown, flight tests against radars on the Indian Springs AFB range provided mixed results. Trapeze reduced 70MHz returns by 20dB and S-band returns by about 10dB. Overall the U-2’s radar cross section (RCS) was reduced to a point that halved its detection range – in other words, the return from a treated aircraft (referred to as Dirty Birds by the Skunk Works engineers that worked on them and Covered Wagons by the operational pilots) was the same as an untreated aircraft located twice as far from the radar head. But the problem with these modifications were that they added weight and drag to the U-2, reducing its maximum range by about 20 per cent and its altitude by 5,000ft, and none of the operational pilots relished the prospect of being closer to Soviet fighters.

On 6 May 1957, Bissell and Dulles briefed Eisenhower on Aquatone and the expected results of Rainbow. Bissell believed that the majority of treated U-2s undertaking Soviet overflights now stood a good chance of avoiding detection entirely, and in the proportion that were detected, their continuous tracking would be extremely difficult, as would interception, even after the Soviets had developed aircraft or missiles capable of reaching the U-2’s altitude. On the basis of such a positive briefing, preliminary approval was granted for more Soviet overflights, despite the fact that phase one of Project Rainbow had not yet been completed.

In June one Dirty Bird was deployed to each of the U-2's three OLs. Two penetration flights of the Soviet Union were made from Turkey on 21 and 30 July 1957 to evaluate the effectiveness of the treatment. Despite Trapeze, Wires and Wallpaper, analysis of the aircraft's System 5 (a multi-band radar recorder) revealed that Soviet radars had been alerted to its presence as it was flying directly towards or directly away from the radar head. This led to the conclusion that radar returns had emanated from the U-2's inlets, cockpit and exhaust, none of which could be treated by the systems developed thus far. Clearly a far more radical approach to the problem was required.

Bissell knew that this next stage of the project would be both hi-tech and high risk. It was essential that the US government was kept appraised of progress without compromising project security. Therefore, on 19 November 1957, he wrote a memo to Deputy Secretary of Defence Donald Quarles, in which he outlined progress to date and his overall plan for the project's next step. He emphasized that the bulk of governmental expertise in radar research lay within the Air Force and Navy, not the CIA, and that 'the most intimate cooperation' would be needed. He noted that the three services would try to limit discussions with manufacturers and avoid issuing formal requirements that could stimulate unusual interest in the concept of a 'radar invisible' aircraft. Once an acceptable design had been developed, a crash programme would produce eight to 12 aircraft. Finally, Bissell recommended that the response to any questions from the Foreign Intelligence Board should avoid any description of the concept, simply stating that a system was being studied with great urgency, that funding and management were under control, and that if the system proved feasible there would be a recommendation for action.

To assist him in evaluating the proposals, Bissell once again called upon the services of Edwin Land to serve as chairman of an advisory panel. Taking its chairman's name, members of the Land Panel (some of whom had served on the Beacon Hill study group) varied slightly over the coming months, but when they first met in November 1957 the panel consisted of Ed Purcell, Allen Donovan, Bissell's assistant Eugene Kiefer, H. Guyford Stever (head of the engineering department at MIT), and the Air Force's chief scientist, Courtland Perkins.

Between July 1958 and the late summer of 1959 the committee would meet on six further occasions to discuss, evaluate and recommend the various designs. The meetings usually took place in Land's Boston office and almost always included the Air Force's Assistant Secretary for Research and Development, Dr

Joseph Charyk, and his Navy counterpart, Assistant Secretary of the Navy (Air) Garrison Norton, as well as various designers from several aircraft manufacturers.

Frank Rodgers at the Lincoln lab was certainly up for a radical approach to the RCS challenge. He returned to basic research in a bid to understand the relationship between a radar return and the physical shape of the target without regard to the aerodynamic practicality of such shapes. To his surprise he discovered that if a metal saucer shape were treated by layering circular sheets of Teledeltos paper (a paper with a constant resistance) on top of the shape, with the first sheet of greatest diameter and each successive sheet being smaller, by the time the sixth sheet was positioned, resistance was down to 300Ω (ohms) – the same as in the free space through which the radar wave was moving. This prevented reflections completely, effectively rendering the shape invisible to radar.

Rodgers had produced a broad-band treatment that was effective against any radar operating at any frequency within a very broad range. This was in contrast to the 'narrow-band' techniques developed and applied to the Dirty Birds, whereby if a radar were encountered operating at a frequency different from that which the treatment had been designed to defeat, its effectiveness was significantly reduced. Unfortunately, the shape of the vehicle was aerodynamically unstable, but Bissell was extremely impressed and Rodgers and Norm Taylor were instructed to present the findings to Johnson. Rodgers began to explain that the ideal shape for a stealthy aircraft was a flying saucer, to which Kelly replied, 'For Christ's sake!' adding that he couldn't make a real aircraft that shape, and that clearly Rodgers knew nothing about aerodynamics. To which an equally headstrong Rodgers retorted that Johnson obviously knew nothing about radar. That was the end of the meeting!

After analysing the discussion, Rodgers and Taylor decided that it wasn't the idea that had been wrong, but their presentation. In the future they wisely decided that they would leave the final design of the aircraft to Johnson and instead feed him RCS guidelines that he could incorporate into his design.

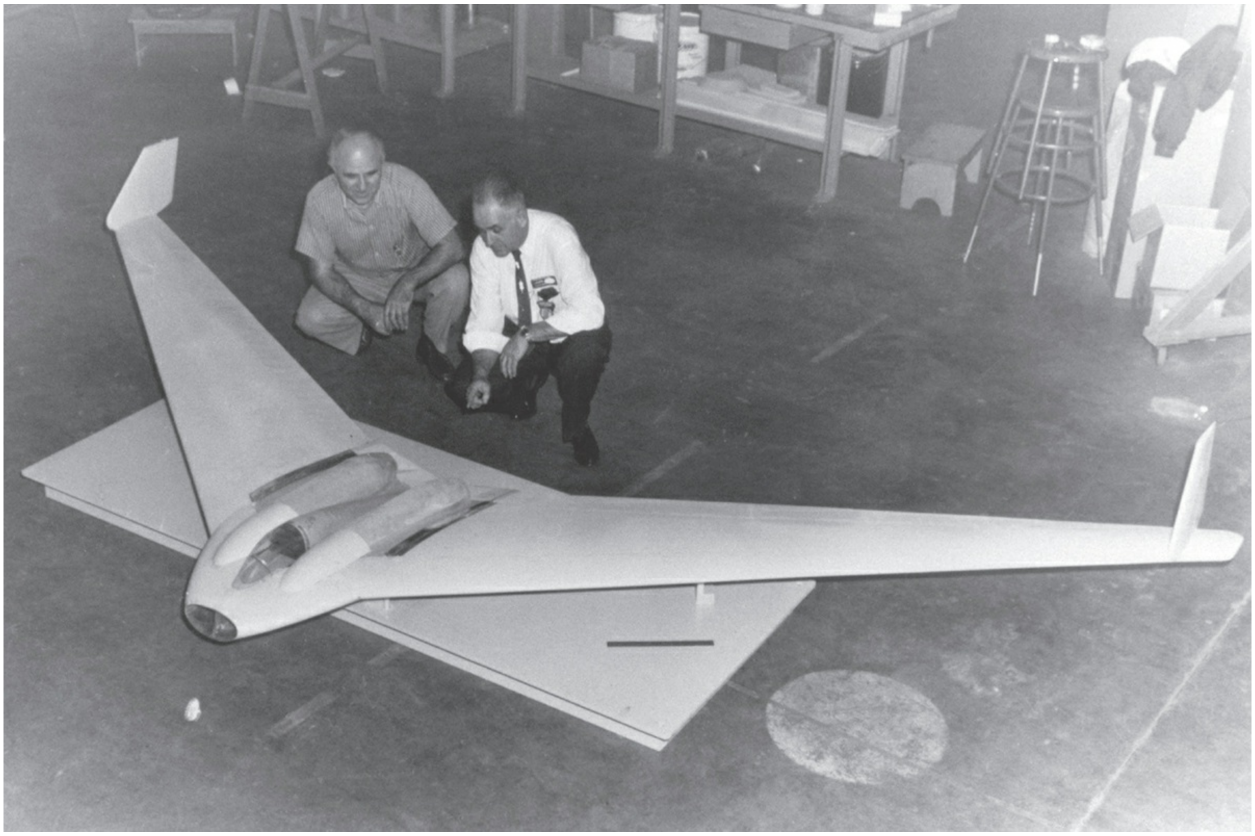
Back at the Lincoln lab, concern was being expressed in some influential circles that work being conducted by Rainbow for the CIA was inappropriate. So in October 1957 it was moved out to a building in Cambridge, Massachusetts, where it was incorporated into the Scientific Engineering Institute (SEI), a Boston-based CIA proprietary. The move also prompted changes within the team, although Frank Rodgers stayed.

Johnson of course had his own team of electronic engineers working on the problem back at the Skunk Works. Ed Lovick recalls:

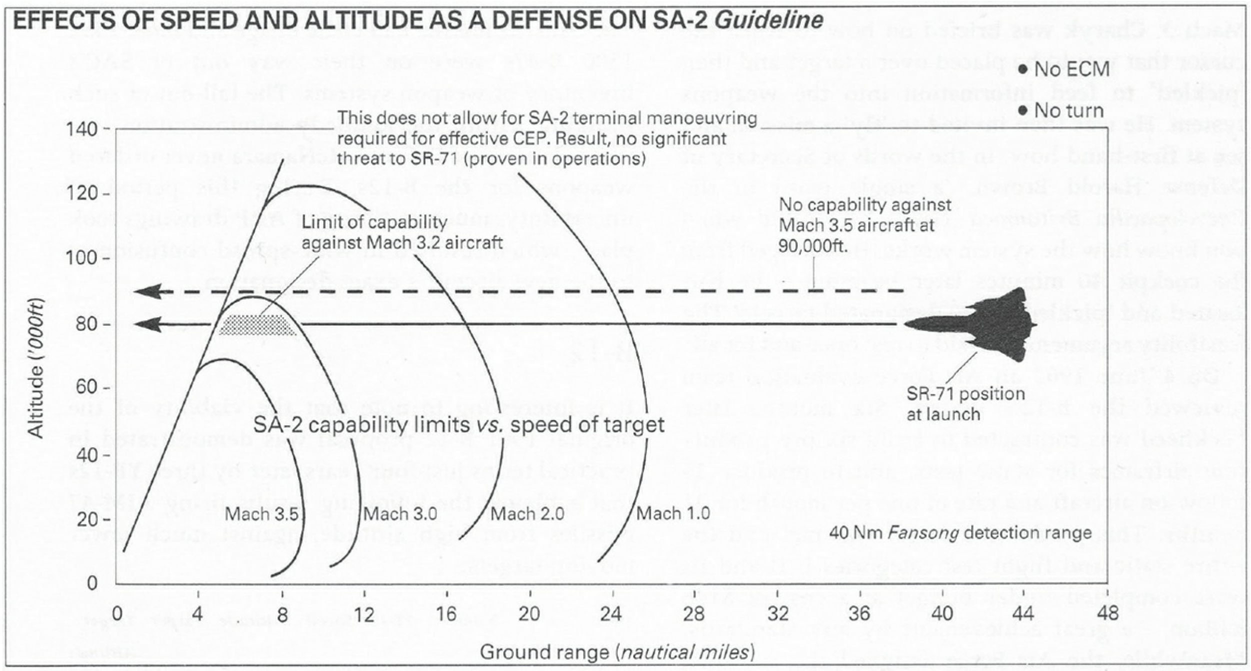
> Kelly thought that an aircraft made of plastic materials might have sufficiently small low-frequency radar backscatter to defeat the 70MHz early warning radars. I warned him that it would not and that you'd see the internal structure, the square corners it formed and the fuel.

But Kelly wanted to test it anyway. Despite the fact that it was known that practical fibreglass structure would be dense enough to scatter 4in. S-band radar waves, he still hoped that an all-plastic airframe might not backscatter 14ft wavelengths significantly. The engine, landing gear and any other metallic items were to be hidden by an, at that time, unspecified means. Several all-fibreglass models that incorporated appropriate internal plastic structures were built and tested. One model was to ⅛ scale and too large for indoor testing, so it was tested at Indian Springs AFB.

Backscattering measurements showed that the thick plastic sections required for strength, and especially corners, were very reflective. When kerosene fuel was added to the interior of the wings, the reflections increased and became characteristic of a solid piece of plastic. When the fuel in partially filled tanks was vibrated and standing waves occurred, the backscatter increased even more.



Model of the subsonic Gusto 2A. (Lockheed Martin)



This vividly illustrates the relationship between speed, altitude and dwell-time, when flying against an SA-2 surface-to-air missile system. (Osprey)

After attempts to hide the structure, fuel and simulated engines yielded poor results, and Kelly agreed to abandon the idea.

More gloomy news followed in January 1958, when two intelligence assessments of Soviet interception capabilities had been compiled. They indicated that the only areas where the U-2 could fly without certain detection were central Siberia and to the east of Tashkent towards China. Two new types of radar had been detected and, in addition, it was considered likely that limited numbers of a specially designed fighter having the ability to operate above 70,000ft would soon be available. SAMs were also expected to become a serious threat to Aquatone from 1959 onwards. The pressure was now on to rapidly develop and deploy a stealthy U-2 replacement.

January 1958 saw the Agency assign the classified cryptonym Gusto to phase two of Rainbow, and at the end of the month Kelly Johnson wrote to Bissell proposing a four-point work statement for Gusto, which was approved on 11 February. However, since it remained possible for Soviet radar operators to continue to locate and track U-2s equipped with the anti-radar systems that had thus far been developed, the CIA cancelled Project Rainbow in May 1958. It was also at about this time that Lockheed built its first anechoic chamber in which to measure the RCS of various design models.

Johnson and some of the key members of his team, including Dick Boehme, Ed Baldwin and Harry Combs, now began working on a number of high-risk, subsonic designs, with low RCS their top priority. They'd formulate a shape with minimum RCS values and then work on ways to make it fly within the specified performance envelope. This series of designs was known to the Agency as Gusto Model 2, and over the following months Lockheed studied numerous design permutations under this overarching code name.

One rejected design had notches cut into the leading and trailing edges of its wings, into which were inserted triangular wedges of graded dielectric material. This technique, called 'edge softening', avoided generating an abrupt change in resistance of the incoming radar beam when it first met the aircraft (it is these abrupt changes that generate reflections). Using this technique, when the incident beam strikes the baseline of the triangle (located at the outer edge of the aircraft), it is reflected inside the wedge, generating electrical currents that turn the radio wave's electromagnetic energy into heat. The resistance progressively reduces to zero by the time the energy reaches the tip of the triangular wedge, at which point it matches that of the adjacent metal structure. Invented by Ed Lovick, the technique would play an important role in reducing the RCS of Johnson's ultimate design.

SUNTAN

In addition to working on projects Aquatone, Rainbow and Gusto for the CIA, Kelly Johnson also began working on an Air Force project. Mindful that the U-2's ability to safely execute deep penetration missions, particularly over the Soviet Union, would inevitably be time limited as a result of expected advances in anti-aircraft technology, Air Force analysts at Wright Field had embarked upon a series of studies into U-2 replacement options even before the type's first flight.

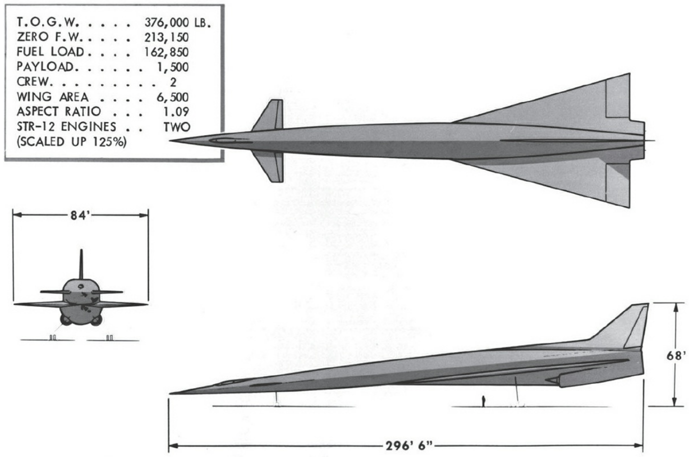
Despite various post-war studies in the United States proving that liquid hydrogen was a viable, albeit volatile fuel for rockets and aircraft, nothing in the way of concept flight testing had been undertaken. However, on 24 March 1954, a British engineer named Randolph Rae personally delivered to the Air Force's new development offices at Wright Field a proposal outlining the development of a unique liquid hydrogen-fuelled aircraft. Propeller-driven, the design was optimized to cruise at an altitude in excess of 75,000ft and cruise at a speed of about 500mph. Although these performance figures were in themselves outstanding, it was the Rex I engine that particularly interested the Air Force engineers.

Randolph Rae was formally associated with the Summers Gyroscope Company, but during the subsequent review process of his drawings and calculations at Wright Field, the company was quietly acquired by the Garrett Corporation specifically to gain access to the engine patent. The ensuing, protracted litigation continued to follow the Rex I throughout its life.

The Skunk Works became involved in the project in mid-1954 when, under the original proposal, it was agreed that it would be provided with $50,000 to conduct an airframe analysis. However, ongoing legal problems over the patent issue delayed contract ratification between Rae and the Garrett Corporation until October 1955. All seemed on track until the Air Force issued its work statement a few weeks later; it called for a high-altitude supersonic design, the range of which was of secondary importance.

Not wishing to forego Air Force funding allocated for the Rex engine – one of the three designs now available was for a supersonic cruise aircraft – Garrett decided to pursue an airframe study that had earlier been given to Rae and since the Skunk Works had been involved in the initial airframe negotiations in 1954, it was invited to provide airframe input. However, after reviewing Garrett's data, the Skunk Works engineering team concluded that the proposed engines would be incapable of producing the thrust required to meet the Air Force performance specification. Further calculations indicated that their engines needed to be 50 per cent more powerful if the desired cruise speed of Mach 2.25 was to be achieved. This forced the Air Force to evaluate Garrett's ability to build such an engine.

On 15 February 1956, two Skunk Works design proposals, designated CL-325-1 and CL-325-2 and powered by the supersonic Rex III liquid hydrogen engine, were presented to the Air Force at Wright Field. However, after extensive studies the Air Force became convinced that Garrett was incapable of building an engine as complex as that proposed and on 18 October 1956 it issued a directive demanding that all work on both projects be stopped, except for the completion of a final summary report.



Project Suntan's CL-400 design provided Johnson with important insights into possible fuels for the U-2 replacement. (Lockheed Martin)

Impressed by the notion of a hydrogen-fuelled aircraft and encouraged by the

Air Force to develop a U-2 follow-on, Kelly Johnson and his Skunk Works team had begun their own studies into the concept a year before cancellation of the Rex III design submissions. During a Pentagon meeting with Lt Gen Donald Putt, head of ARDC, in early January 1956 Kelly offered to build two prototype hydrogen-fuelled aircraft powered by more conventional engines and have them delivered within 18 months of contract signing. Based upon the CL-325, they would be capable of cruising at an altitude of over 99,000ft at a speed of Mach 2.5 and have a range of 2,500 miles.

With the Air Force suitably impressed, a second meeting was held at the Pentagon on 18 January, during which it was decided to fund studies to verify Kelly's proposal and select a qualified manufacturer to design and build a hydrogen-fuelled engine. By the end of February, proposals from Pratt & Whitney and General Electric had been reviewed and on 1 May 1956 a six-month study contract was signed with Pratt & Whitney for the engine and with the Skunk Works to evaluate airframe configuration and material options. Air Force programme management was headed by Lt Col John Seaberg, assisted by Maj Alfred Gardner (engine development) and Capt Jay Brill (logistics). As the aircraft's mission would be the penetration of denied territory, just 25 people were cleared into this special-access-required programme, codenamed Suntan.

In 1956, the Skunk Works signed a contract to produce four production aircraft for the Air Force, in addition to the two prototypes and a single static test specimen; the design was now designated CL-400.

Having joined the Skunk Works in 1954 as an entry-level engineer specializing in thermodynamics, Ben Rich became a key member of the Suntan project and was involved in the feasibility studies that would prove liquid hydrogen was safe and practical to produce in large batches. To produce the highly volatile fuel, a production facility was established in a remote corner of the Lockheed complex at Burbank airport that had served in World War II as a communal air raid shelter for workers from a nearby B-17 Flying Fortress factory. As Ben later noted, 'It had 8ft thick walls and underground bunkers and was located about as far away from the rest of the Skunk Works as it could be, in case something went wrong and we blew up!'

Ben and 13 Skunk Works personnel set to work. In less than three months they were producing more than 200 US gallons of liquid hydrogen per day, within the walled compound that had become known as Fort Robertson after project worker Dave Robertson. Despite the temperamental nature of the fuel, not a single accident occurred and visitors cleared into the project for site tours were often given Martini icicles; the gin and vermouth mixture was poured into a Dixie cup, a lollypop stick inserted and the complete ensemble then immersed in liquid hydrogen; the result was a frozen Martini on a stick!

On 18 August 1957, Pratt & Whitney had completed its first Model 304 engine. It was transported from the facility at East Hartford, Connecticut, to P&W's new plant at West Palm Beach, Florida. On 11 September static tests were initiated, using nitrogen to check the engine's rotating elements and fuel system. During October the first runs took place, followed by a second series in December after engine inspection. A second engine began tests on 16 January 1958, and an improved motor, designated Model 304-2, was delivered and tested for the first time on 24 June. The trials went extremely well, Pratt & Whitney and the Air Force gaining considerable confidence in the hydrogen-fuelled units.

All seemed to be running according to schedule. The Air Force had allocated $95 million to Suntan, Kelly had ordered no less than 2½ miles of aluminium extrusion for airframe production, the 304 engine continued to perform as planned, the Air Products company was constructing a large hydrogen liquefaction plant in Florida, and MIT was working on an inertial guidance system.

But over the next six months something continued to bother Kelly. Despite having successfully sold the aircraft to the Air Force, it was becoming increasingly apparent to him that the CL-400's severe range limitations could not be designed out. The design fell short of its estimated original lift-over-drag ratio by 16 per cent, while stretching the fuselage to increase fuel capacity by way of compensation would result in only a 3 per cent increase in range. Meanwhile, Pratt & Whitney estimated that no better than a 5–6 per cent improvement in specific fuel consumption (SFC) could be achieved with its Model 304 engine over a five-year period of operation. Such low growth potential, coupled with the logistical problems associated with pre-positioning liquid hydrogen to forward operating locations, convinced Kelly that 'the aircraft was a dog'. In March 1957, during a meeting with James Douglas Jr, then Secretary of the Air Force, and Lt Gen Clarence Irvine, Deputy Chief of Staff for Materiel, Kelly bluntly informed them of his misgivings.

A meeting of the Land Panel between 22 and 23 September 1958 finally resolved any lingering misgivings when it voted to terminate Suntan. The Skunk

Works returned almost $90 million and the opportunity for the Air Force to wrestle back the strategic overflight programme from the CIA slipped from its grasp.

On a positive note, however, Project Suntan had provided Lockheed with an improved understanding of high-speed flight as well as confirmation that hydrocarbon fuel and not hydrogen was the best choice for the proposed flight regime, since hydrogen was so difficult to handle. It also provided Kelly with a major change in direction for Project Gusto.

SUPERSONIC GUSTO

The dichotomy for Kelly Johnson was the seemingly inverse relationship between 'stealth' and performance, which would be a recurring theme throughout his design submissions for a U-2 replacement. A conventional design was most likely to deliver the required performance, but often proved too easily detected by radar, whereas a design emphasizing stealth struggled to deliver the prerequisite performance. Johnson was also concerned by the speed of Soviet radar development which, coupled with the inevitable use of more diverse radar frequencies would, he was convinced, further complicate the search for a panacea to these conflicting paradigms. Therefore, on 21 April 1958, probably as a hedge against these problems, Johnson began sketching his first Mach 3 design for the Agency, which put extreme speed and altitude performance at the heart of vehicle 'survivability' rather than stealth.

He named the design in his notebook 'U-3'. 'I drew up the first Archangel proposal for a Mach 3.0-cruise airplane having a 4,000nm range at 90,000 to 95,000ft.' (This notebook would subsequently become known as his 'Archangel' notebook: Skunk Works insiders often referred to the high-flying U-2 as 'Kelly's Angel', and since this new design represented another performance leap, 'Archangel' seemed a logical extension).

To power the ADP design, two engine types were examined, the Pratt & Whitney J58 and General Electric J93. By June, studies concluded that the former would provide superior performance. Over a number of days, Johnson continued to refine and further investigate the high-speed design before reporting his findings to Bissell.

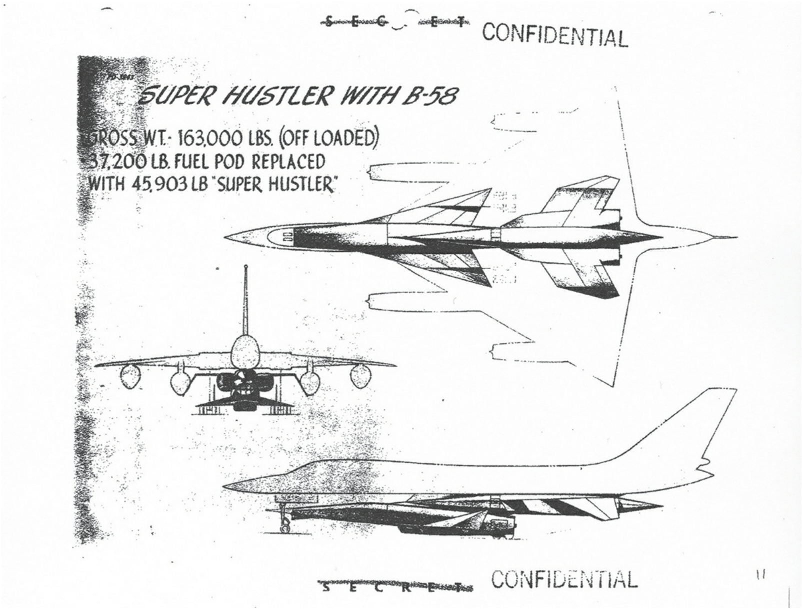
Under Frank Rodgers, a team from the SEI conducted a blip-scan analysis of Johnson's U-3 proposal. Taking into account the design's speed, altitude and RCS, they were able to evaluate the dwell time in which the aircraft would remain within a radar beam, and therefore its probability of detection. Three frequencies, 70, 600 and 3,000 megacycles per second, were considered in these computations, and the subsequent report was highly significant, becoming known as the 'Blip-Scan Study' and also the 'Rodgers Effect'. It identified specific design targets that became enshrined in the programme, namely a speed of Mach 3, an altitude of 90,000ft, and an RCS of not more than 10 square metres and preferably less than five.

THE COMPETITOR

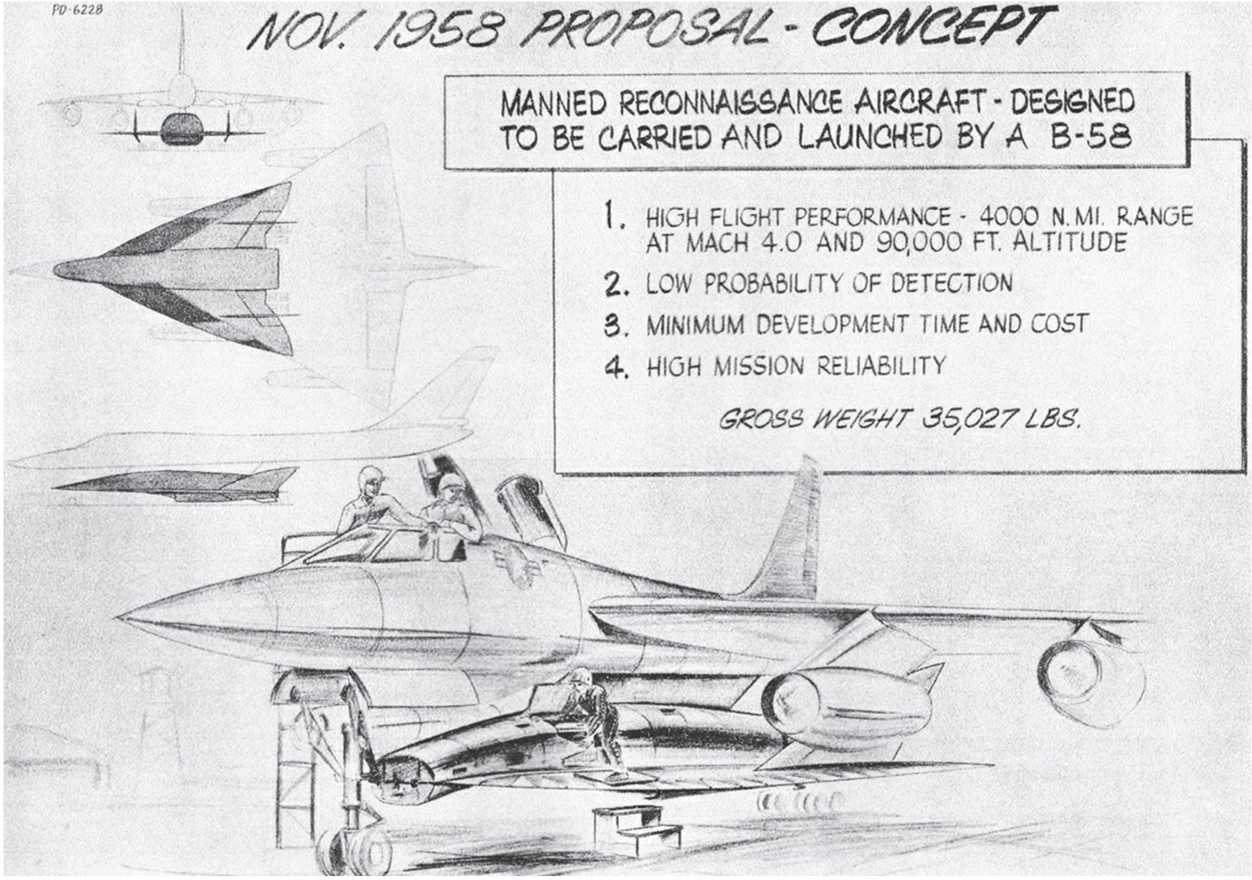
In the spring of 1958, Bissell flew to Fort Worth, Texas, where he met Robert H. Widmer, head of advanced development at the Convair Division of General Dynamics. Bissell told Widmer that he required a reconnaissance aircraft capable of flying undetected at 90,000ft, with a 4,000-mile range and 2,000lb payload. As he had with Lockheed, Bissell kept his initial requirements simple and without a written specification. Bissell stated in his memoirs that he brought Convair into the project on a point of due diligence and also to assuage any criticism when it came time to possibly awarding a multi-million-dollar contract.

However, others on the inside track have gone on record as saying it was done because Johnson was more concerned about taking an aerodynamic quantum leap than minimizing the RCS of a U-2 successor (the latter being something that President Eisenhower himself had insisted upon). Therefore this precipitous action also provided Bissell with leverage to use against Johnson when he thought the Skunk Works boss was not focusing enough on RCS design issues.

Convair's first proposal in the competition was based upon a radical variation of a design called Super Hustler. This nuclear bomber would have used a modified B-58 bomber to carry aloft a two-stage parasite aircraft, the aft section of which would later be jettisoned to increase overall range. The front, manned section carrying the weapon was to have been powered by ramjets for cruising and a turbojet for landing. The proposed reconnaissance variant required a number of significant changes, not least because jettisoning sections of an aircraft over hostile territory was hardly covert! In addition, Super Hustler was not stealthy. So a team of seven principal design engineers, under Donald R. Kirk, began working on what they referred to as the First Invisible Super Hustler or FISH.


SECRET CONFIDENTIAL
SUPER HUSTLER WITH B-58
GROSS WT. 163,000 LBS. (OFF LOADED)
37,200 LB. FUEL POD REPLACED
WITH 45,903 LB "SUPER HUSTLER"
SECRET CONFIDENTIAL

Convair used its Super Hustler design as the basis for entry into Project Gusto. (Convair)

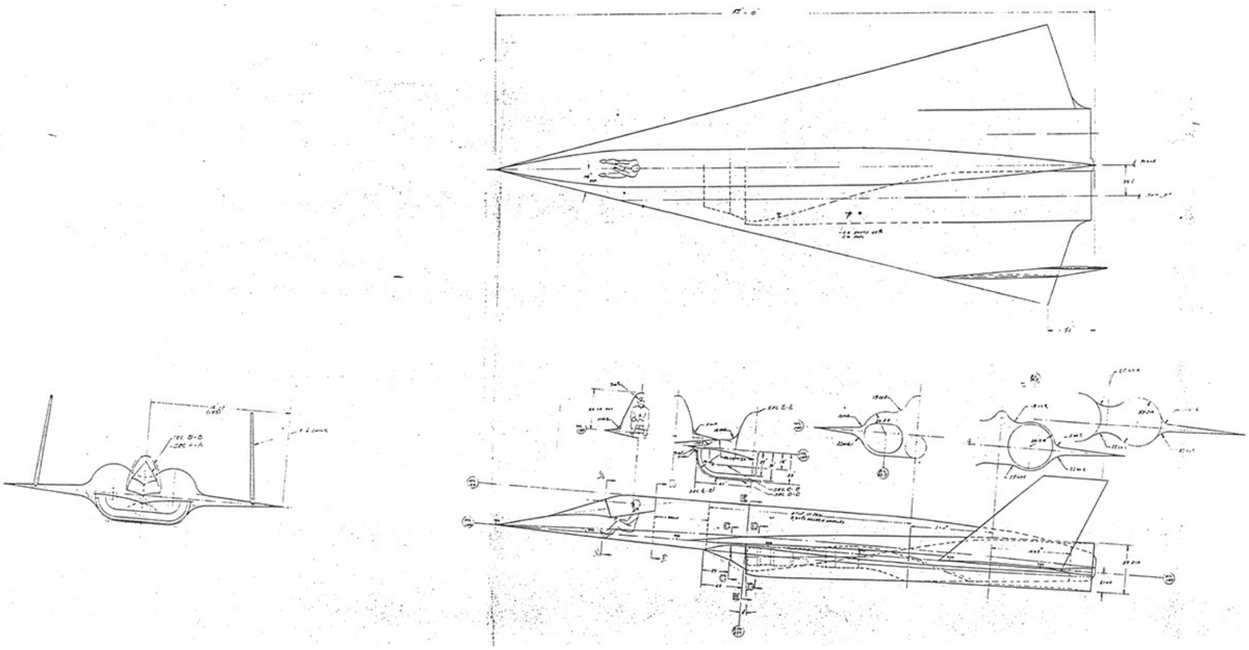

PD-6228
NOV. 1958 PROPOSAL - CONCEPT
MANNED RECONNAISSANCE AIRCRAFT - DESIGNED TO BE CARRIED AND LAUNCHED BY A B-58
1. HIGH FLIGHT PERFORMANCE - 4000 N.MI. RANGE AT MACH 4.0 AND 90,000 FT. ALTITUDE
2. LOW PROBABILITY OF DETECTION
3. MINIMUM DEVELOPMENT TIME AND COST
4. HIGH MISSION RELIABILITY
GROSS WEIGHT 35,027 LBS.

Convair's First Invisible Super Hustler (FISH) was a radical design, combining extreme speed and altitude with a very small RCS. (Convair)

Consisting of only the front section of the Super Hustler design, crew numbers for FISH were reduced from two to one. Its offset, pressurized cockpit escape capsule (a feature that would later be incorporated into General Dynamic's F-111 design) meant the pilot did not require a full pressure suit (unlike the Lockheed designs), which greatly reduced crew fatigue. To provide the pilot with an external view of the outside world when in flight, two TV cameras were mounted in the nose.

FISH would be powered by two Marquardt ramjet engines burning high-energy fuel (HEF). To achieve the necessary ramjet start speed, the small parasite vehicle would be launched from a specially modified B-58B flying in excess of 35,000ft at Mach 2.2. FISH would then accelerate to Mach 4.2, cruise at 90,000ft and have a range of 3,900 miles. Having completed its mission, it would decelerate and two Pratt & Whitney JT12 turbojets would be extended from the upper fuselage to power the aircraft back to base.

An order from SAC for a stretched version of Bob Widmer's B-58A – shown here – equipped with uprated engines was an essential element of Convair's FISH proposal. (Convair via Jay Miller)

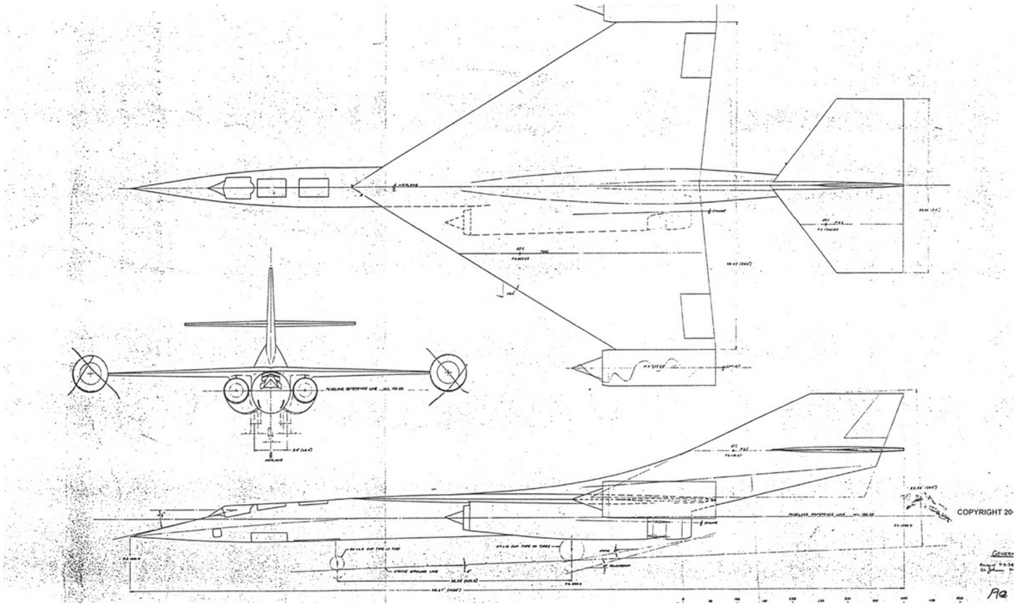


Drawn by Dan Zuck on 4 December 1958, Arrow was the result of a request made to Johnson by the Land Panel during a meeting to undertake a 'sanity check' of Convair's FISH proposal. Lockheed highlighted likely operational problems with the design, namely the unreliability of ramjets in cruising flight and the power deficiency of the proposed single JT12 turbojet to be used during the landing phase. (Lockheed Martin)

To reduce its RCS, the designers changed both the leading and trailing edges of the wing from straight lines to arcs of circles. To withstand thermodynamic heating caused by flying at such high speeds, the steel honeycomb wings incorporated wedge-shaped Pyroceram inserts on both the leading and trailing edges. A ceramic material, Pyroceram was also impregnated with graphite to absorb incident radar energy, thereby reducing the vehicle's RCS. The project was codenamed Idiom by Bissell's office, and on 22 June 1958 the work was formally moved into Gusto.

On 23 July 1958, Johnson attended a meeting at Land's Cambridge office and presented Archangel and Gusto 2A. He noted in his log that both designs were 'well received'. A Navy commander also present alluded to a Navy idea for an inflatable aircraft and Bissell requested Kelly's comments on the concept.

A week later, on 31 July, the advisory panel met to formally discuss both Lockheed concepts, during which Bissell noted that reasonable progress was being made, but that he thought the way forward would become clearer after the September advisory panel meeting.



Archangel 1. (Lockheed Martin)

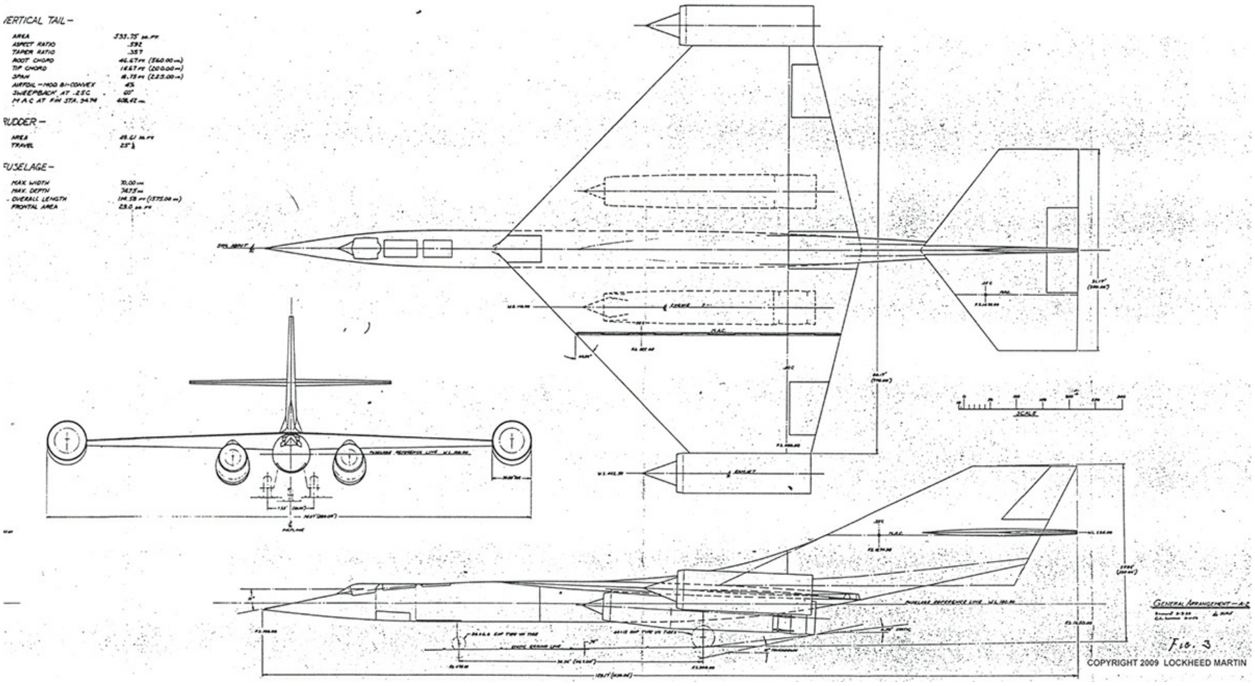
Provided with details about the intriguing Navy concept, Kelly conducted a thorough evaluation for Bissell. Under the Navy project name Champion, Goodyear was proposing a reconnaissance vehicle with inflatable wings that could be rolled up while in transit aboard an aircraft carrier and inflated for launch. It was envisaged that the ramjet-powered vehicle would be lifted to altitude by balloon and cruise at between 125,000 and 150,000ft. A quick calculation by Johnson determined that the balloon would need to be more than 1 mile in diameter! A more detailed study followed in which a tug aircraft was also evaluated, but the unreliability of the concept for reconnaissance over highly sensitive areas was enough to ensure that it did not progress. On 25 August 1958, Johnson noted in his log:

> Have contacted Marquardt and P&W, and gotten some ramjet data. Have reconfigured the Archangel to include wing tip ramjets, as per our proposal on the F-104 to the Air Force in 1954. This appears to give us an airplane which would cruise at Mach 3.2 at 95,000 to 110,000ft for the full distance.

However, Archangel 2 made no concessions to reducing RCS.

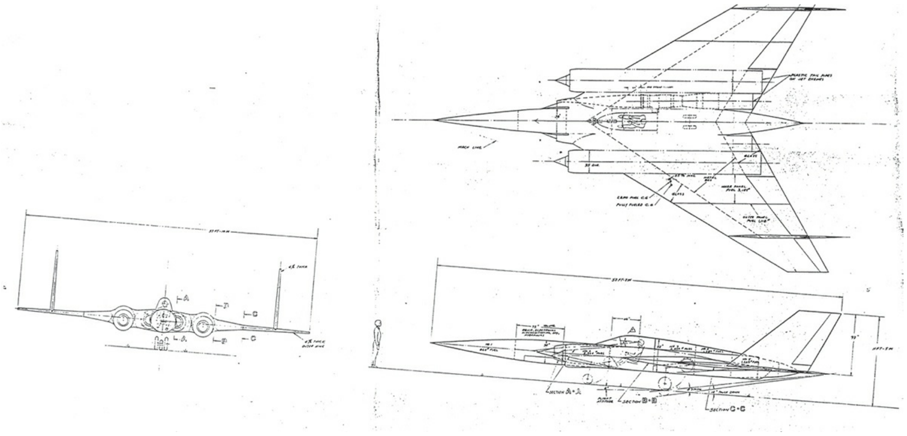
The Land Panel convened in Boston between 22 and 23 September and Johnson and Widmer presented their designs independently. The panel consisted of Bissell and Kiefer, Din Land, Ed Purcell, Frank Rodgers and Guyford Stever. From the Air Force were Gen Swofford, Col Norman Appold and Col John Seaberg, Maj Bob Hippert, US Navy Admiral Struble and Dick Horner. The panel decided to terminate further studies into Champion and Suntan and voiced interest in the Convair design, but rejected Archangel 2 primarily on the grounds of its poor RCS. Gusto 2A, the board contended, required further development. Kelly noted, ‘We left Cambridge rather discouraged with everything’.

Five days after the Boston meeting, Johnson began making notes on what would become his A-3 design. Including two wingtip ramjets and two JT12A turbojets in the fuselage, Kelly assigned the concept to Dan Zuck, Ed Baldwin and Henry Combs. Continuing the angel theme, the team worked on several design permutations, referring to them as cherubs, since they were smaller than Archangel.

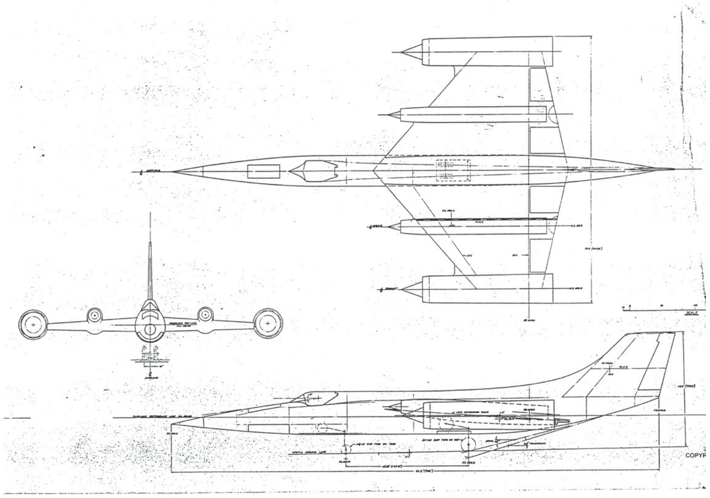

ERTICAL TAIL –
AREA 533.75 SQ. FT
ASPECT RATIO .592
TAPER RATIO .357
ROOT CHORD 46.67 FT (560.00 IN)
TIP CHORD 16.67 FT (200.00 IN)
SPAN 18.75 FT (225.00 IN)
AIRFOIL – MOD BI-CONVEX 4%
SWEEPBACK AT .25C 60°
M A C AT FIN STA. 34.74 408.42 IN
UDDER –
AREA 49.61 SQ. FT
TRAVEL 25° ±
USELAGE –
MAX. WIDTH 70.00 IN
MAX. DEPTH 74.75 IN
OVERALL LENGTH 114.58 FT (1375.00 IN)
FRONTAL AREA 23.0 SQ. FT
SCALE
GENERAL ARRANGEMENT – A-2
FIG. 3

COPYRIGHT 2009 LOCKHEED MARTIN

Archangel 2. (Lockheed Martin)



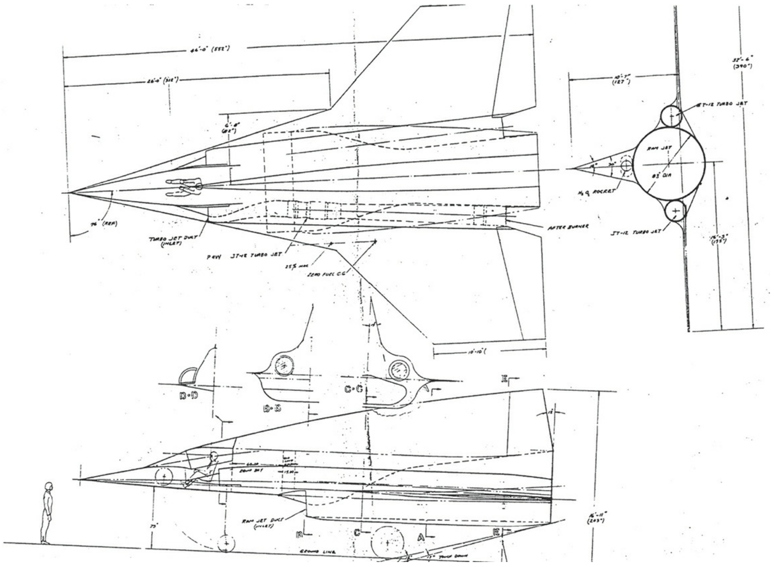
Archangel 3. (Lockheed Martin)



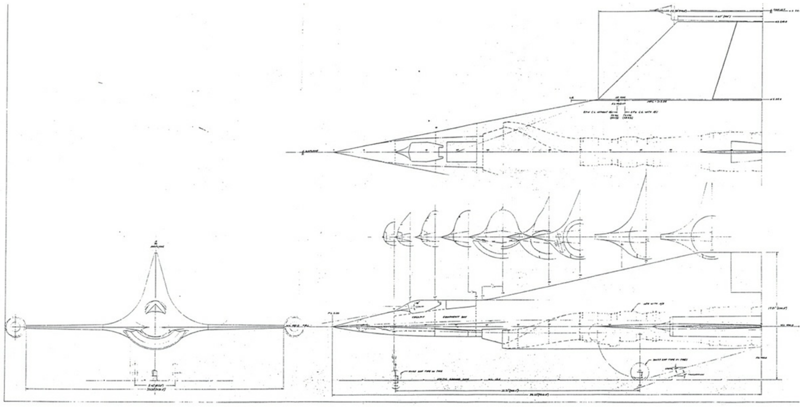
Design iteration of Archangel 3. (Lockheed Martin)

On 30 October Ed Baldwin completed the final A-3 design, which had a length of 62ft 4in., a span of 33ft 9½in. and weighed in empty at 12,000lb. Despite the relatively low levels of thrust generated by the two turbojets, it was believed that they were capable of getting the A-3 up to ramjet speed, which would then enable the vehicle to reach Mach 3.2 at a cruise altitude of 95,000ft; range was projected at 4,000nm. But weight issues dogged the design and when L. D. MacDonald and his team conducted RCS measurements on two scale models, the returns averaged out as the same for those of the U-2, which were much larger than for the all-metal Gusto 2S, which was itself larger than for Gusto 2A, which incorporated RAM.

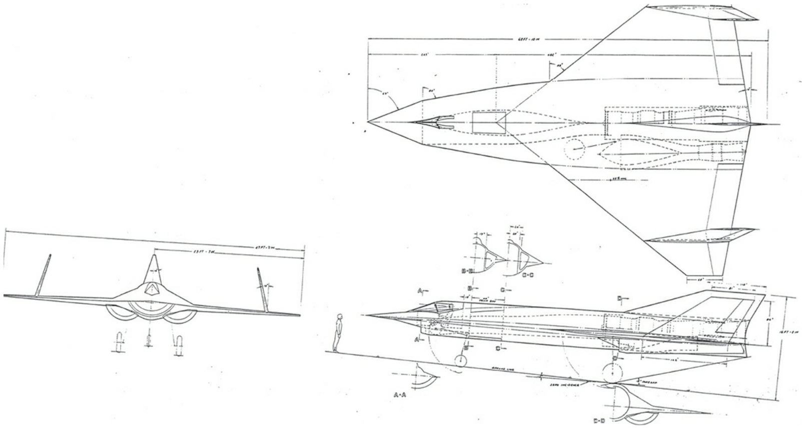
On 12 November 1958, Johnson and Widmer presented their designs to the Land Panel – Johnson the A-3 and Widmer FISH. Three days later the panel communicated its findings to James Killian, the president's scientific advisor. Its recommendation was that FISH be selected, but should this design later prove unable to meet 'the desired technical features', the board would wish to review other alternatives before firmly recommending a second choice (the A-3). Bissell called Johnson with the bad news on 26 November, pointing out that actually the two designs compared quite favourably, but the crunch issue had again been RCS, an area where Convair was still clearly ahead.


46'-0" (552")
26'-0" (312")
6'-8" (82")
76° (REF)
TURBO JET DUCT (INLET)
P&W JT-12 TURBO JET
25% MAC
ZERO FUEL C.G.
AFTER BURNER
10'-7" (127")
32'-6" (390")
JT-12 TURBO JET
RAM JET
83" DIA
H_2O_2 ROCKET
JT-12 TURBO JET
16'-3" (195")
10'-10"
D-D
B-B
C-C
E
RAM JET DUCT (INLET)
B
C
A
E
GROUND LINE
16'-11" (203")

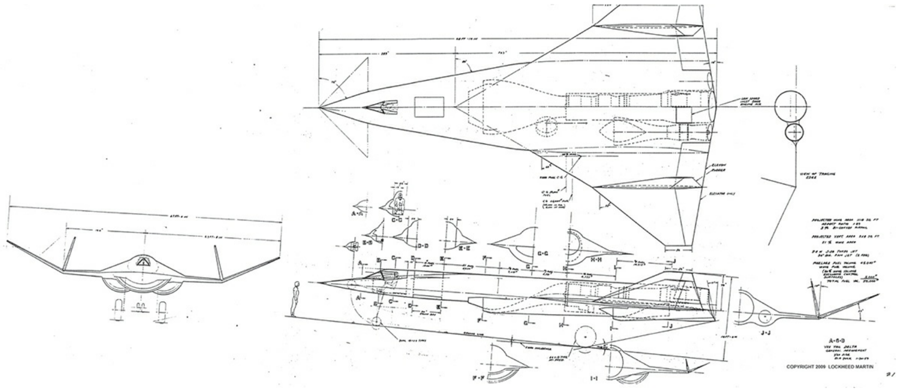
Archangel 4. (Lockheed Martin)



Archangel 5. (Lockheed Martin)



Design iteration six of Archangel 6. (Lockheed Martin)

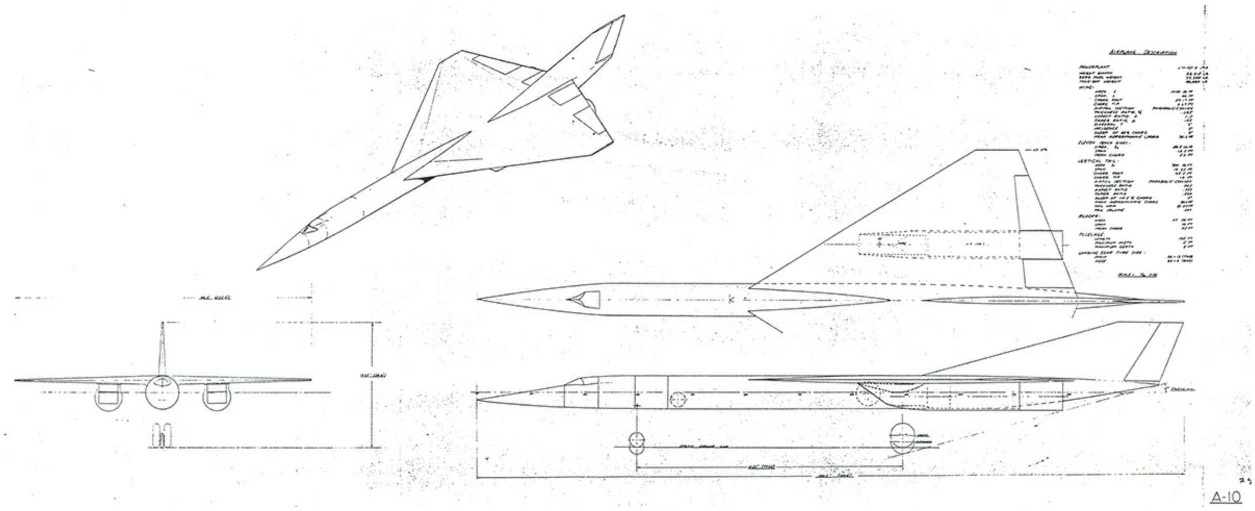


Design iteration nine of Archangel 6. (Lockheed Martin)

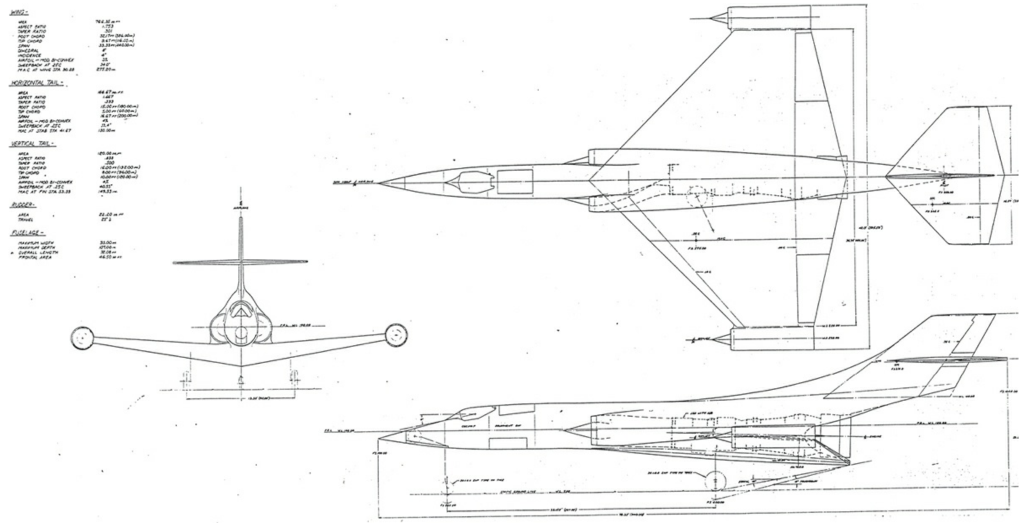
A major operational disadvantage of FISH was its reliance upon a carrier aircraft for launch. The board's decision to reject the A-3 had caused Johnson to focus his next set of designs on reducing RCS values to a minimum, while retaining the vehicle's ability to launch itself independently. Therefore, beginning on 26 November and over the next two months Johnson and his team worked on designs designated A-4, A-5 and A-6. They used an idea of Frank Rodgers' to incorporate chines beginning at or near the nose that blend into the fuselage and merge into the leading edge of the wings. The designs were also of small size, with their vertical surfaces hidden above the wings.

At the beginning of January 1959, before design studies had been completed on the A-6, Johnson instructed his team to work on a series of small non-stealthy designs designated A-7 through A-9. Each powered by a single J58 turbojet and two ramjets, none of the designs was subsequently judged to be viable; their range was inadequate, typically 1,640nm, and despite their size the RCS was too great.

Following the 12 November meeting, Convair began developing production plans, awarding subcontracts for the design of various subsystems in addition to conducting work that would refine and test various elements of its FISH design. It was during almost 300 hours of wind-tunnel testing of 1/17-scale models that problems were identified. The drag coefficient acting on the B-58 with FISH in place was almost double that of a 'clean' aircraft. This meant that instead of the usual three minutes to accelerate from subsonic speed to Mach 2, it would take close to nine. In addition, FISH needed to be lengthened to improve stability and carry additional fuel; this meant the B-58 needed to be 5ft longer. Neither of these were issues for the B-58B since it was both longer and had uprated J79-9 engines; the problem was that the new bomber was as yet unfunded.



Design iteration two of Archangel 7. (Lockheed Martin)

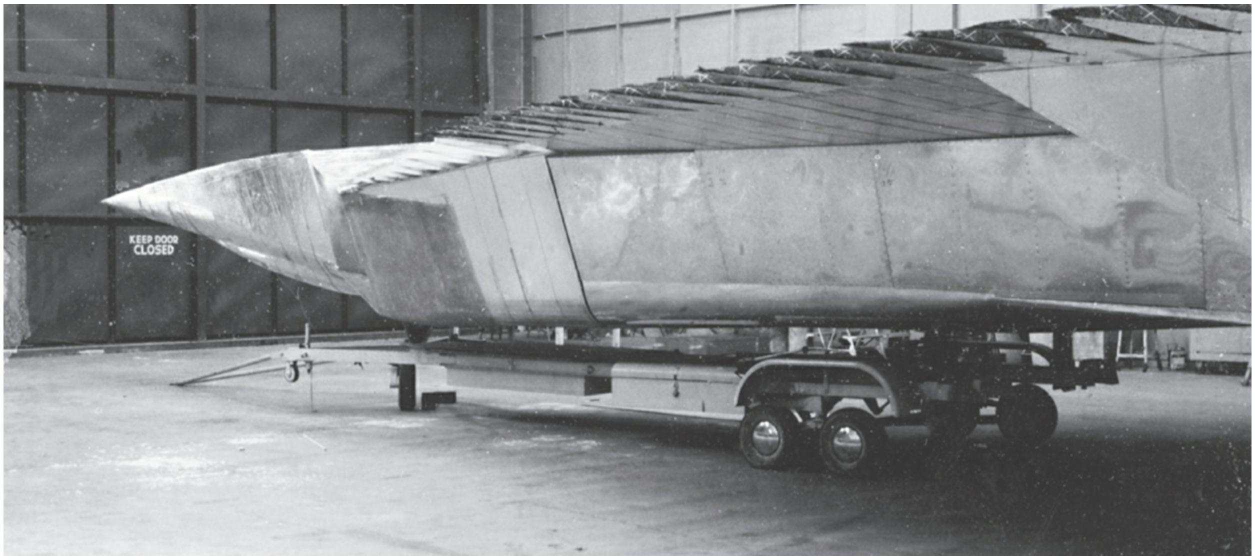

WING -
AREA
ASPECT RATIO
TAPER RATIO
ROOT CHORD
TIP CHORD
SPAN
DIHEDRAL
INCIDENCE
AIRFOIL – MOD BI-CONVEX
SWEEPBACK AT .25C
MAC AT WING STA
HORIZONTAL TAIL -
AREA
ASPECT RATIO
TAPER RATIO
ROOT CHORD
TIP CHORD
SPAN
AIRFOIL – MOD BI-CONVEX
SWEEPBACK AT .25C
MAC AT STAB STA
VERTICAL TAIL -
AREA
ASPECT RATIO
TAPER RATIO
ROOT CHORD
TIP CHORD
SPAN
AIRFOIL – MOD BI-CONVEX
SWEEPBACK AT .25C
MAC AT FIN STA
RUDDER -
AREA
TRAVEL
FUSELAGE -
MAXIMUM WIDTH
MAXIMUM DEPTH
OVERALL LENGTH
FRONTAL AREA

Archangel 10 – powered by two J93s. (Lockheed Martin)

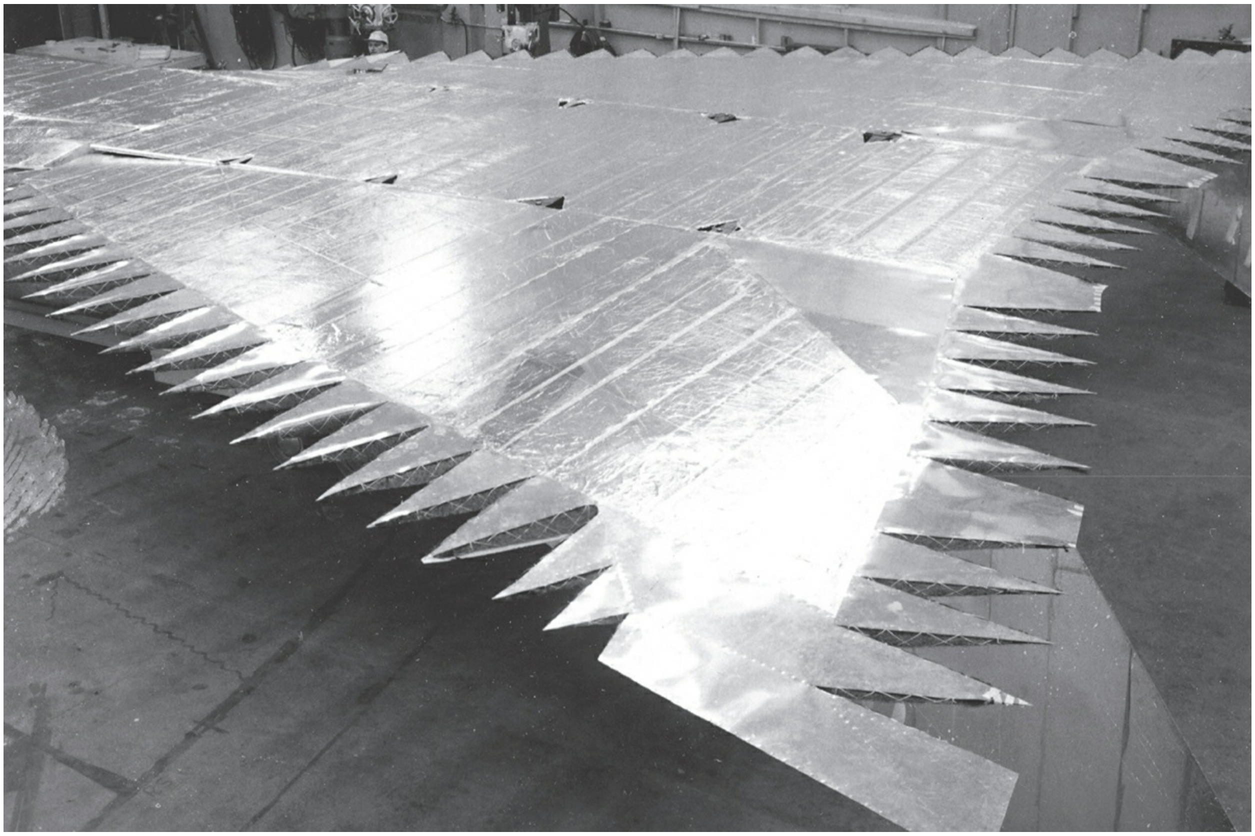
Having progressed through a series of small stealthy and non-stealthy designs, Johnson returned to his original Archangel concept for a purely performance-driven design with no concessions to reducing RCS. Pursuing this philosophy resulted in the A-10 and A-11 designs.

Employing the J93 turbojet, the A-10 was 16,000lb lighter than Archangel and therefore able to gain an additional 2,500ft at mid-mission altitude. It was able to cruise at Mach 3.2 at 90,500ft and had an operational radius of 2,000nm. However, it transpired that the J93 engines were 18 months behind the development of the J58, so in March 1959, the Lockheed team began work on what it believed would be its final major design in the series, the A-11. Designed specifically to use air refuelling, it would have a range in excess of 13,000 miles and complete an eight-hour round-robin mission from the United States without the inherent political and security issues associated with operating such aircraft from a foreign base.

Dulles, Bissel, Killian, Land and Purcell briefed Quarles and President Eisenhower on the progress of Gusto on 17 December 1958. The DCI reviewed the results of the U-2 missions to date and stated that he believed its successor 'would have a much greater invulnerability to detection'. Bissell then described the A-3 and FISH designs, noting that there was some deliberation whether the platform should be an air-launched or a conventional take-off vehicle, adding that the next phase would be detailed engineering, at the end of which it was proposed that 12 aircraft be ordered at a cost of about $100 million. Eisenhower supported the purchase, but stated that more thought would be given to the matter before such an order was placed. Quarles then noted that the CIA, Department of Defense (DoD), and Bureau of the Budget (BoB) were working on a funding plan for the project. At the close of the meeting Eisenhower asked the group to return after completing the next work phase to discuss further stages of the project with him.



Kingfish was Convair's heavily revised proposal following its failure to gain B-58B orders from SAC. (Convair)



The wing planform of Kingfisher featured serrations to the leading and trailing edge into which RAM, capable of withstanding extremely high thermodynamic temperatures, was fixed to reduce the platform's RCS. (Convair)

On 22 December, Convair was given the go-ahead to proceed with detailed design development of FISH. Twelve aircraft were to be bought and it was thought that a minimum of one B-58 launch aircraft would be required for every four FISH. Since SAC was operating a wing of B-58 bombers from Carswell AFB, the base provided ready cover and security for project FISH, and its close proximity to Convair's Fort Worth plant was also an advantage.

On 18 February 1959, following an internal CIA restructure, an office hitherto known as the Development Project Staff was re-designated as the Development Projects Division (DPD). One of the components of this organization was the 1007th Air Intelligence Service Group (AISG), which served as a cover unit for DPD Air Force assignees, but on 17 June this too was re-designated and became the 1149th Special Activities Squadron. It was this unit that would operate the new high-flier.

Nonetheless, on 18 May 1959, at the request of Gen Thomas White, Air

Force Chief of Staff, a CIA/Air Force working level technical panel was formed to further examine the issue of finding a U-2 successor.

By the end of May the SEI team at Cambridge had completed a comparison evaluation between the A-11 and FISH and its report, recommending the A-11, was forwarded to the Land Panel, which again met the two competing teams independently in Boston, on 9 June. The committee adjourned without making a decision. However, it did conclude that sporadic detection and tracking by radar was inevitable, regardless of the platform. On the flight back to Burbank, Johnson was convinced that Lockheed was out of the competition.

In the end it wasn't the Land Panel that decided the fate of the two designs, but SAC. In June 1959, Widmer accompanied his corporate boss, J. T. McNarney, and other senior Convair directors to a presentation to be given to senior SAC officers that included General Curtis LeMay (Vice Chief of Staff of the Air Force). Convair's objective was to sell the capabilities of the B-58B to the Air Force. However, to make the earlier B-58A commercially viable, the company needed first to sell more A models.

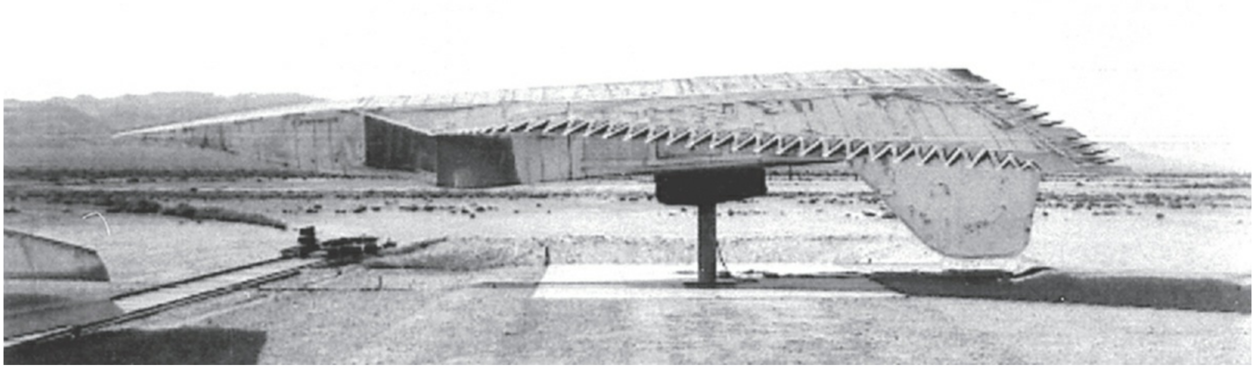
The presentation seemed to have gone well. LeMay liked what he saw and asked, 'When can I have this?' Unfortunately for Convair, he did not like the answer, and when McNarney told the notoriously fiery general that the B-58B would be available after SAC had purchased another three wings of B-58As, LeMay stormed out! Consequently, the B-58B was never ordered by the Air Force, and without its mother ship, the parasite FISH would not be built either. Convair was instructed to undertake a colossal amount of work, completely redesigning FISH as a single-stage platform that would not be reliant upon a mothership. Furthermore, it was stipulated that the new design should be powered by two Pratt & Whitney J58 turbojets.

On 3 July 1959, Richard Bissell, Director of the Program Office, visited Kelly and extended the Lockheed programme, agreeing to accept the lower cruising altitudes that would be obtained with a version of the A-11 adopted in shape and treatment to reduce its RCS. Kelly noted in his log, 'I proposed the A-12, with J58 engines in a mid-wing arrangement, the use of chines on the fuselage and serrations on the leading-edge incorporating radar treatment.'

The Convair team now pulled out all the stops, working through design iterations designated Smelt, Herring and, finally, Kingfish (which is perhaps as well, since it's difficult to imagine any pilot wanting to brag about flying an aircraft named Smelt). Remarkably, in just over two weeks it had not only decided upon the basic design, but had also considerably modified the FISH radar model into the larger Kingfish configuration, and from 15 August 1959 used it to undertake a series of 70MHz radar tests at Indian Springs AFB – the results of which would turn out to be similar to those achieved by the A-12.

The origins of the basic Pratt & Whitney J58 engine (known to the manufacturer as the JT11D-20A) can be traced back to late 1956, when its centreline was laid down. The project propulsion team, led by William H. Brown, consisted of 27 engineers during the initial stages of the engine's design studies and development. They included William Gordon, the Pratt & Whitney Florida general manager, Don Pascal, Norm Cotter, Dick Coar and Ed Esmeier.

Initially a company-funded project, the US Navy began sponsoring its development to power a proposed Mach 2.5 attack aircraft capable of a dash capability up to Mach 3 for several seconds. Designed to generate 26,000lb of thrust with afterburning at sea level, the so-called J58-P2 engine successfully completed 50 hours of ground running acceptance trials in August 1958. However, the spiralling costs associated with the overall concept caused the US Navy to cancel the project (instead it ordered the McDonnell F4H, initially powered by two Wright J65 engines, later replaced by two General Electric J79-GE-2s).



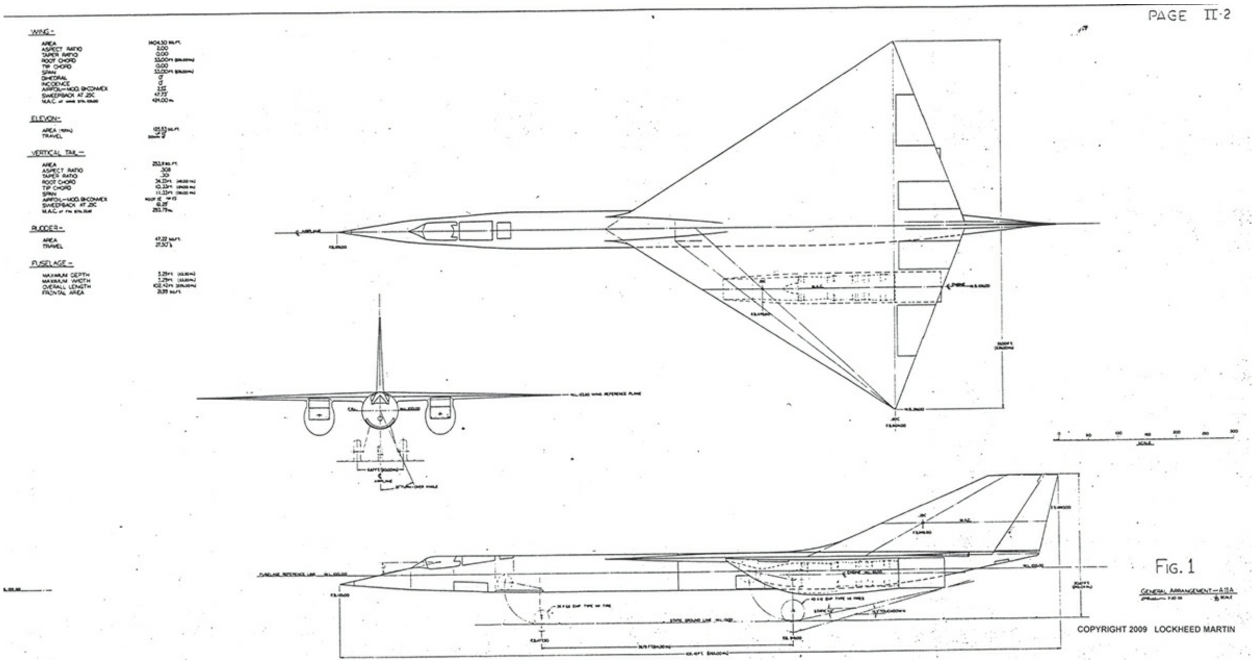
Kingfish under RCS test at the Indian Springs AFB Radar Test Scatter (RatScat) range. (Convair)

By mid-1959, Pratt & Whitney had completed approximately 700 hours of full-scale testing on the J58. However, because of the sustained, extremely hostile environmental conditions under which the engine would operate in a Kingfish or A-12 application, the only design parameters that could be retained from the original P2 engine were its basic size and the compressor and turbine aerodynamics – and even these were modified at a later date.

Back at Burbank, L. D. MacDonald and Ed Lovick advised Dick Fuller how best to modify the A-11 design into the reduced RCS A-12. This included using chines – once these had been applied, a cross section of the fuselage forebody resembled a two-dimensional flying saucer! The wings were blended into the fuselage and engine nacelles, while the twin fins were made of composite material and canted inboard at 15°. Other more subtle RCS reduction innovations included incorporating Ed Lovick's serrations, applied to the wing leading and trailing edges as well as the chines, and filled with dielectric material. The A-11's rectangular inlets were replaced with round, axisymmetric units, while the translating spike used to regulate mass airflow into the inlet not only helped shield the engine compressor face from incident radar energy, but was itself covered in RAM. A proposal by Edward Purcell of the Land Panel was also seized upon by the Skunk Works team, which used caesium as an additive in the fuel, decreasing the RCS of the engines' afterburner plume.

On 14 July 1959, Bissell and the Land Panel, together with James Killian, met and discussed the pros and cons of FISH, Kingfish, the A-11 and A-12, in addition to reports speculating about the possible capabilities of the new Soviet 'Bar Lock' radar. At the 9 June meeting, a final decision regarding which design to recommend wasn't made, but those present did begin to formulate a briefing to be taken by Dulles and others to President Eisenhower six days later.

On 20 July 1959, Dulles and the Land Panel informed President Eisenhower that Project Gusto was making good progress. Concerned about the U-2's continued vulnerability and the significant problems embroiling the Corona photo-satellite project, the president gave his final approval to the high-speed reconnaissance project.



Archangel 11A. (Lockheed Martin)

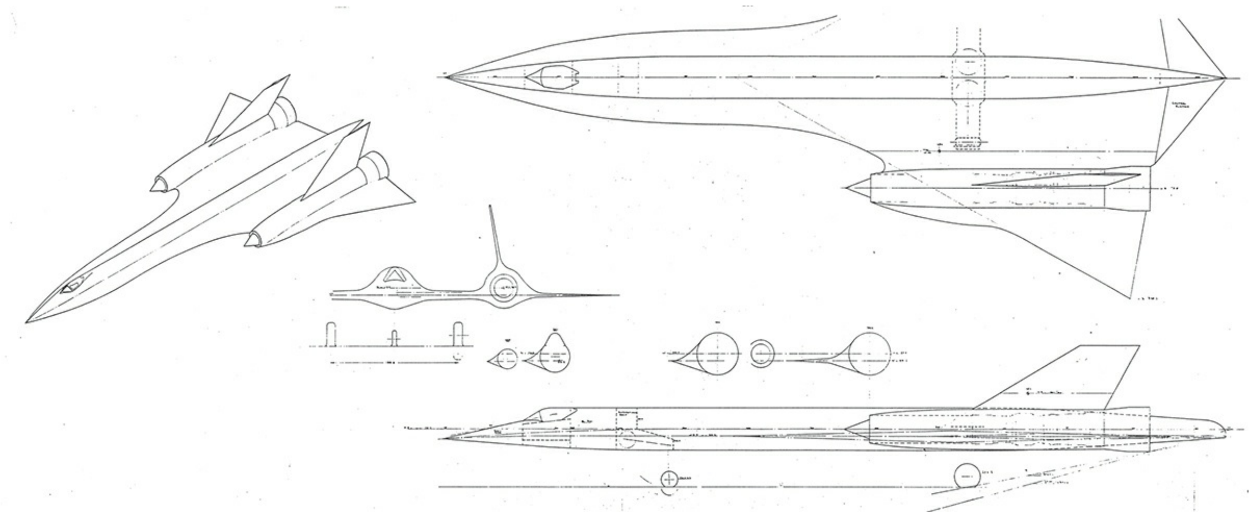
Final proposals from Convair and Lockheed were submitted on 20 August 1959 to a joint DoD, Air Force and CIA selection panel. Interestingly, despite the strikingly different external appearance of the two designs, their performance was very similar:

	A-12	**Kingfish**
Speed	Mach 3.2	Mach 3.2
Range (total)	4,120nm	4,000nm
Range (at altitude)	3,800nm	3,400nm
Cruise Altitudes		
Start Mid-Range End	84,500ft 91,000ft 97,600ft	85,000ft 88,000ft 94,000ft
Dimensions		
Length Span	102ft 57ft	79ft 6in. 56ft
Gross Weight	110,000lb	101,700lb
Fuel Weight	64,600lb	62,000lb
First Flight	22 months	22 months

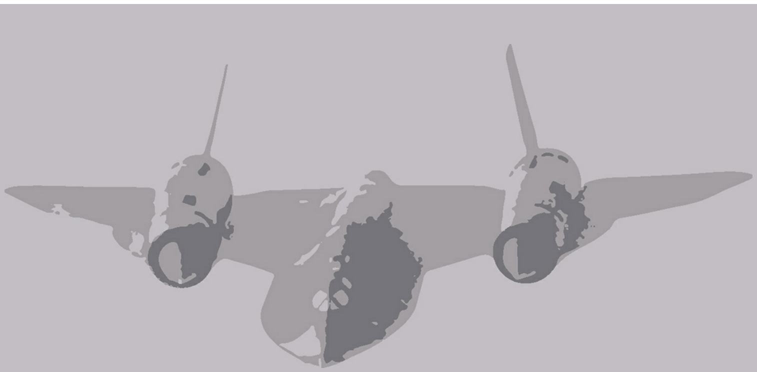
Cost Summary (12 aircraft, no engines)	$96.6 million	$121.6 million

The Lockheed design was preferable in terms of overall cost, but in terms of vulnerability to radar detection the Convair design was superior, and some of the CIA representatives favoured Kingfish. However, Air Force personnel on the panel managed to convince them to support the Lockheed design on the basis that the cost overruns they had experienced on the Convair B-58 project could be repeated by the company in this new high-risk programme, whereas Lockheed had produced the U-2 under budget and on time. Notwithstanding, despite its vote in favour of Lockheed, the panel was concerned about the A-12's inferior RCS results and therefore required the company to prove its concept for reducing the A-12's RCS by 1 January 1960.

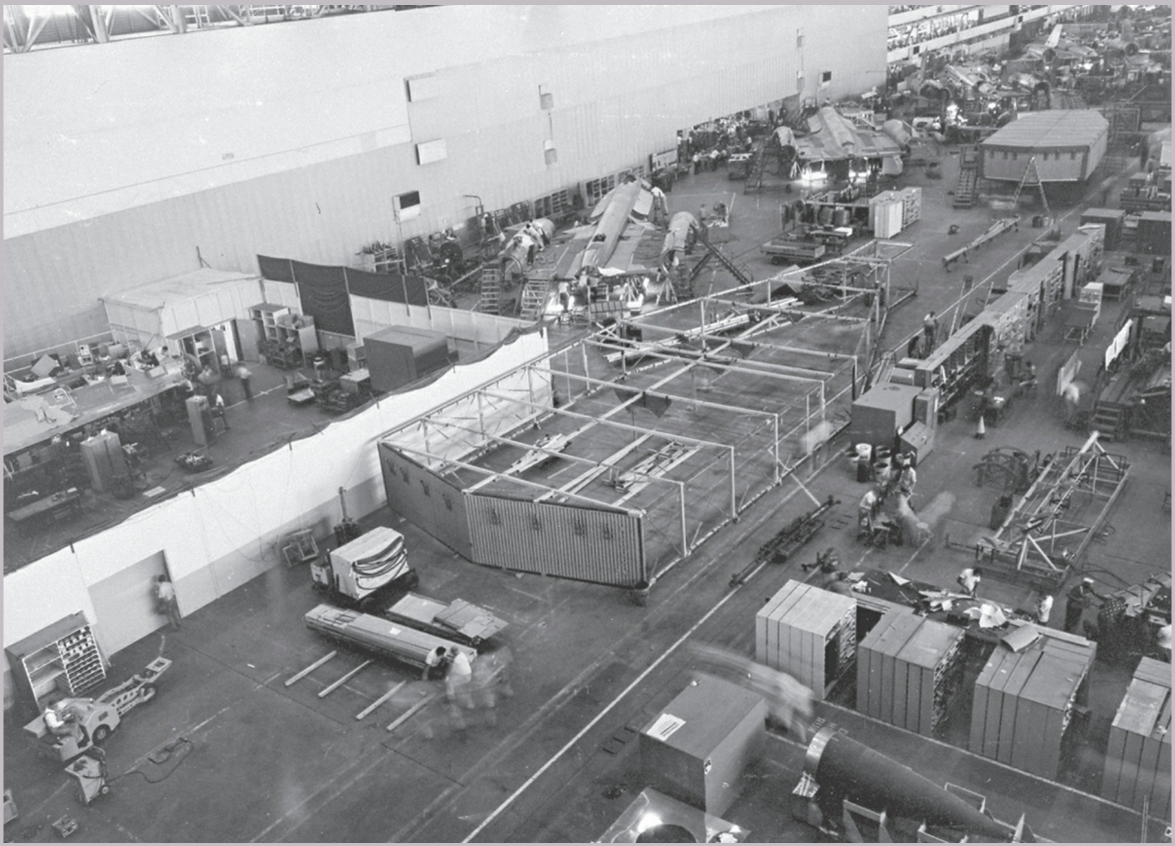
Nine days later, Lockheed received official notification that its design had been selected by the board, and that it would receive $4.5 million by way of an advanced feasibility contract covering the period 1 September to 1 January 1960. Gusto was terminated and the new programme received the classified cryptonym Oxcart. John Parangosky, long associated with Aquatone, was appointed by the CIA as their project manager.



Archangel 12. (Lockheed Martin)



CHAPTER 3:
OXCART



The carriage frame under construction; placed around each A-12 and then covered with fabric, the frame helped maintain security as the aircraft were transported by road to Area 51. Note YF-12 construction under way in an area cordoned off from Oxcart production. (Lockheed Martin)

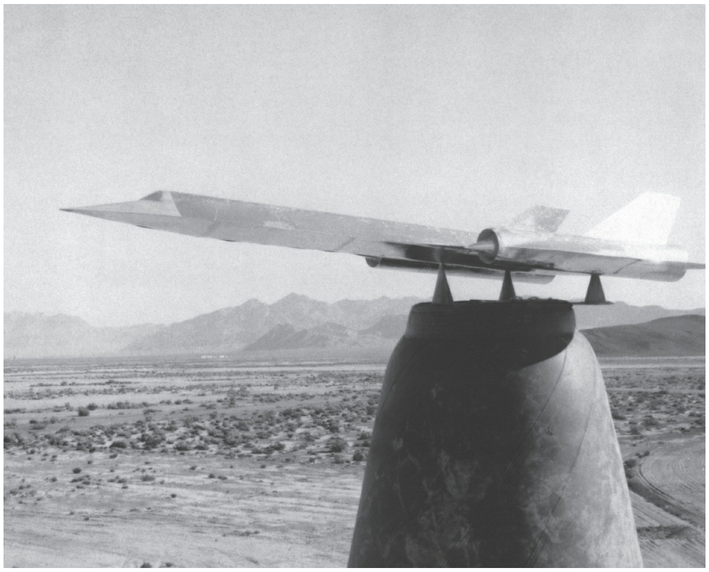
On 31 August 1959, Lockheed began building both full-scale and ⅛-scale mock-ups in Building 82A for RCS testing. In addition, it embarked upon an engineering reorganization and expansion plan.

The full-scale mock-up was to be tested independently by Edgerton, Germeshausen & Grier (EG&G) in cooperation with the SEI, at a small test site at Indian Springs AFB, Nevada. Lockheed objected to this on two counts: first, it claimed the pylon was not robust enough to support its full-scale model, and second, the site was in full view of a nearby highway. On 10 September, EG&G agreed to accommodate Lockheed's concerns by moving its radar test facility to Watertown Strip. With the facility relocated, replete with a larger pylon, the A-12 mock-up departed Burbank in a specially designed trailer on 10 November. Eight days later, the full-scale RSC test model was in place and testing could begin. They soon proved that the basic concept would work.

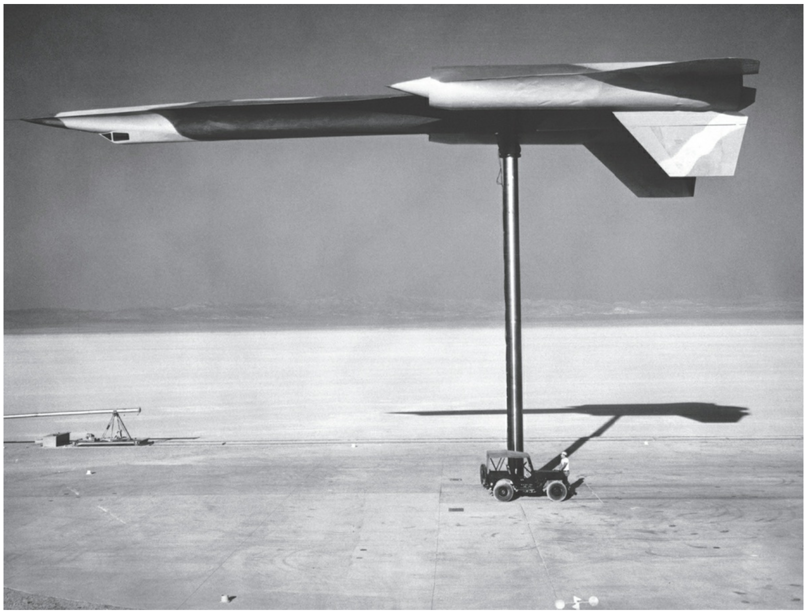
However, it took 18 months of testing and the incorporation of various design adjustments before the A-12 finally achieved a satisfactory RCS. These changes included adding thin curved extensions outboard of the engine nacelles that blended into the outer wing sections. A chine was added on each side of the fuselage forebody and the fins were canted inboard 15°. The new tail units were fabricated from resin-impregnated, non-metallic materials.

Later Oxcarts also incorporated 'edge softening' and their triangular titanium wing and fuselage fillets were substituted for units made from electrically resistive honeycomb asbestos. These were capable of withstanding the thermodynamic temperatures generated at high-Mach flight and absorbed incoming radar energy, rather than reflecting it, thereby further reducing the aircraft's RCS. Initially Johnson was concerned that these measures would have a negative impact on the aircraft's performance, but wind tunnel tests determined that the chines generated additional lift and improved the aircraft's handling qualities.

By mid-January 1960 the Skunk Works had successfully demonstrated that the A-12's RCS had been substantially reduced, but much to the chagrin of Bissell, the weight added in the process had affected the aircraft's altitude performance. Johnson therefore proposed a reduction of 1,000lb in the A-12's structural weight while increasing its fuel load by 2,000lb, ensuring that the proposed target penetration altitude of 91,000ft was achieved.



This early pole model has vertical fins and rudders; the canted-in, all-moving tail units have yet to be incorporated into the design. (Lockheed Martin)



The pole supporting this early A-12 model on the Area 51 RatScat range is yet to be wrapped in the RAM necessary before tests could proceed. (Lockheed Martin)

Satisfied with the changes, Bissell notified Johnson on 26 January 1960 that the CIA duly authorized the construction of 12 Oxcarts; the contract was signed on 11 February 1960. However, due to considerable unforeseen difficulties, the

Skunk Works' original quote of $96.6 million proved more than optimistic. Fortunately for Lockheed, the CIA included a clause within the contract that allowed costs to be re-evaluated. It was a clause that had to be invoked on a number of occasions over the next five years as costs spiralled to more than double the original estimate. Meanwhile, events on the world stage were about to cause seismic tremors in the world of airborne strategic reconnaissance.

MAYDAY

Despite his misgivings, Eisenhower continued to sanction a limited number of U-2 Soviet overflights on the basis of the continuing need to collect intelligence and the ongoing failure of the Corona satellite reconnaissance programme. Then, on 1 May 1960, Soviet radar and SAM technology finally caught up with Project Chalice.

A U-2 flown by CIA pilot Francis Gary Powers was in the vicinity of Sverdlovsk, deep within the Soviet Union, when it was successfully engaged by an SA-2 'Guideline' missile. When the weapon's 180kg warhead, containing 3,600 shotgun-like pellets exploded, it peppered the U-2's tail and aft fuselage, causing catastrophic damage and throwing the aircraft completely out of control. Despite Power's best efforts, he was unable to activate the U-2's self-destruct explosive charges before escaping from the doomed aircraft. Consequently, instead of the craft's remnants descending to the ground as tiny pieces of confetti, it fell in large chunks.

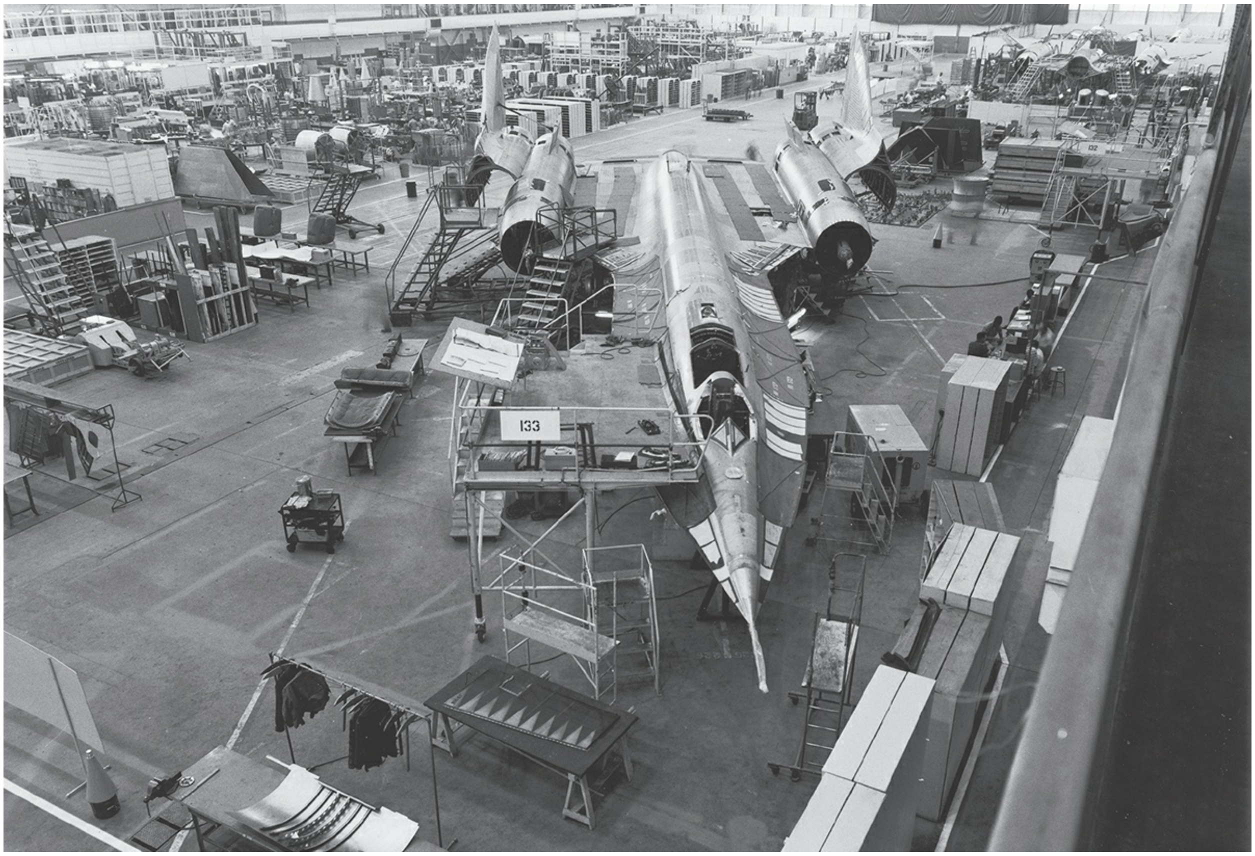
As the hours ticked by and the aircraft failed to arrive at Bodø, Norway, its planned recovery airfield, a feeling of dread percolated through the project headquarters team back in Washington. In Moscow, Premier Khrushchev, a master of political intrigue and subterfuge, knew exactly how to play the situation; he said nothing and waited.

Two days later, under the assumption that Powers had been killed, approval was given by Eisenhower to put out the prearranged cover story in which NASA claimed that one of its U-2 research aircraft 'apparently went down' after the pilot 'reported that he was experiencing oxygen difficulties'. Khrushchev's bait had been swallowed hook, line and sinker; now he struck.

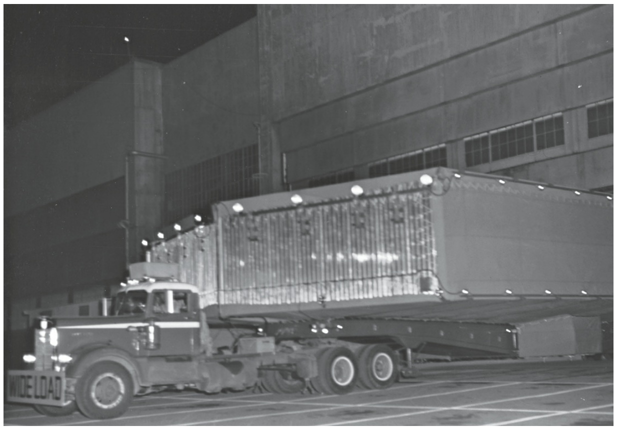
On Saturday 7 May, having returned to the Supreme Soviet, Khrushchev revealed to the world the truth: ‘We have the remnants of the plane – and we also have the pilot, who is quite alive and kicking!’ The wreckage, maps and even film from the camera were recovered, proving beyond dispute precisely the reason behind the flight. Eisenhower was unmasked to the world as a liar. A subsequent mid-May summit meeting in Paris was a disaster, during which Khrushchev walked out after Eisenhower refused to apologize publicly for sanctioning the U-2 overflights (despite having assured the Soviet premier in private, that there would be no more such flights during the remaining eight months of his administration).

Unsurprisingly, a serious question thus arose regarding the future status of Oxcart. On one hand, the shootdown vindicated the decision to develop a U-2 replacement, but on the other it opened up a debate as to whether the United States should continue violating Soviet airspace with its manned strategic reconnaissance programme. An insight into the president’s thinking on the subject can be gained from a top secret memo for the record, dated 2 June 1960 and written by Brig Gen Andrew Goodpaster, military aide to President Eisenhower.

> I spoke to the President early this week about the question of whether work should go forward on the successor to the U-2. After considering the matter, he said he was inclined to think that it should go forward, on low priority, as a high-performance reconnaissance plane for the Air Force in time of war. I suggested it might be useful for Mr Allen Dulles [DCI], Mr Gates [Thomas Gates – defence chief] and Mr Stans [Maurice Stans – Budget Bureau Chief] to get together to consider the matter, and he agreed. He said he did not think the project should now be pushed at top priority. In fact, they might come to the conclusion that it would be best to get out of it if we could. Alternatively, they may feel that we have so much invested in it that we should capitalize on this through carrying it forward.



A-12 Article 133 serial 60-6939 on the Burbank assembly line inside Building 309/310 of Plant B6. (Lockheed Martin)



Dorsey Kammerer was appointed to head the effort to devise, build and implement the A-12's carriage system. Article 122 departed Burbank on 26 June 1962; Article 123 followed in August and the two-seat trainer, Article 124, in November 1962. (Lockheed Martin)

Meanwhile, the Skunk Works team had mountains to climb before Oxcart was anything like operational. It's a story best told by Kelly Johnson through his log, where the first hint of trouble appears in an entry dated 17 August 1960: 'The time has come when I have to announce officially, as well as unofficially, to the customer that we are late. Because of extreme costs of machining, we are probably going to be over cost'. Four months later Johnson's woes were further exacerbated: 'Have a very strong suspicion that P&W are not going to meet their schedule. They have run into trouble on the compressor with the tip shrouds. Of course, they didn't mention this as being a problem.'

On 13 February 1961, the Skunk Works had more problems: 'Having trouble with wing load distribution and have to put a twist in outboard leading edge.' In March Kelly informed the CIA's Deputy Director for Plans (DDP) Richard Bissell that 'schedules are in jeopardy on two fronts. One is the assembly of the wing and the other is in satisfactory development of the engine. Our evaluation shows that each of these programs is from three to four months behind the current schedule.' Bissell's response was curt: 'I have learned of your additional expected delay in first flight from 30 August to 1 December 1961. This news is extremely shocking on top of our understanding as of our meeting 19 December that the titanium extrusion problems were essentially overcome. I trust this is the last of such disappointments short of a severe earthquake in Burbank.'

Things continued on a downward spiral when, on 12 April, Kelly noted in his diary:

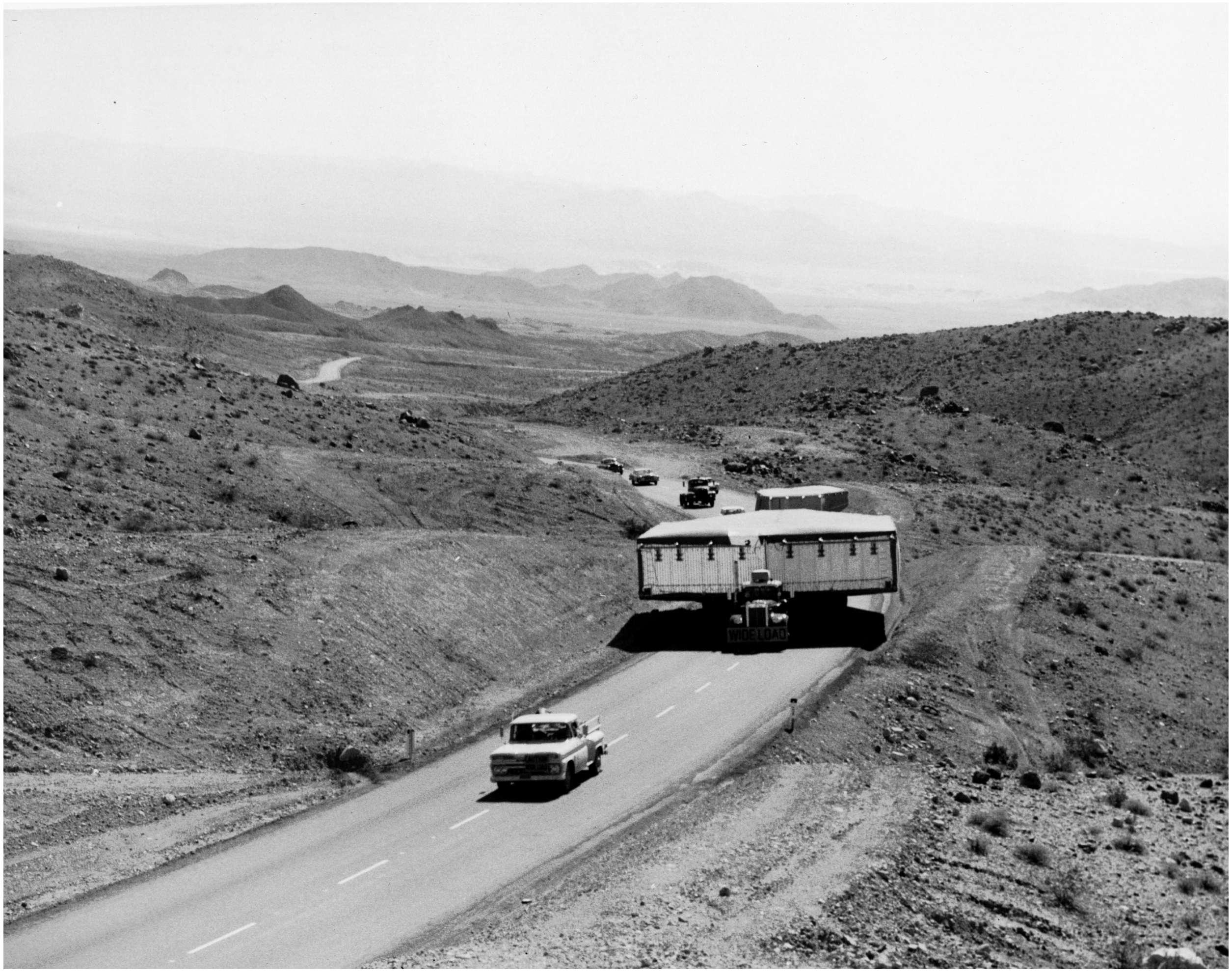
> Some time is starting to build up on the wing. The fuselage looks in good shape. Fighting a whole host of problems on powerplant, ejectors, plumbing, material shortages, lack of space. We are going to fly early in December on some basis, but it's going to be an extremely busy summer and fall. Working three shifts in all critical areas.

On 9 September the aft wing section and forward fuselage were removed from their jigs and mated together perfectly. But this piece of good news became almost insignificant just two days later, when Kelly received word on the J58 engines.

> The day started with P&W coming in prior to the suppliers' meeting and stating that the engines would be 1,000lb apiece overweight, considerably down on performance, and that it would be about March 1962 before we got engines. I was in deep shock for the next week.

Pratt & Whitney provided a little more clarity on the engine issue on 28 September. 'P&W told us the story on the engine, and said that the best delivery date we could get for two engines was March 1962. (They admitted this meant

April, or March 31.)' The next day Kelly wrote, 'After a sleepless night, I decided that we would have to try to fly with a J75 engine, doing everything possible to raise the take-off power, such as using water injection, and higher take-off rpm temperatures, and higher take-off rpm.' The specific engine chosen as an interim replacement for the J58 was the J75-P19WSS, and between 3 and 5 January 1962 Kelly spent time with the engine manufacturer.



A ten-wheeled Kenworth tractor unit hauling the A-12 prototype, Article 121, left Hangar 82, Burbank on 26 February 1962, at 3:30am. It arrived safely at Area 51 three days later. (Lockheed Martin)

On arrival at Area 51's main hangar complex, the articles were off-loaded for reassembly. (Lockheed Martin)

> Had a big meeting with P&W in Florida. I spent a day alone with them. Their troubles are desperate. It is almost unbelievable that they could have gotten this far with the engine without uncovering basic problems which have been normal in every jet engine I have ever worked with… Hamilton Standard are not covering themselves with glory either. It's a good thing we went to the J75, although these engines, too, have troubles and require new compressor discs.

At the beginning of February Johnson wrote, 'Going all-out on finishing airplane #1. Everyone is putting in very long hours and meeting a tough schedule, outlined in one of my project memos. We are having trouble with high temperature greases, bearings and the usual host of last-minute troubles.' Then, at last, on 26 February, 'The convoy left at 3:30am to go to the area. Everything went smoothly and it arrived at 1:00pm Feb. 28. Dorsey [Kammerer] did his usual splendid job of organizing the move.'

Then just as everything looked like plain sailing, the 6 March entry recorded, 'Fuel put in the bird. It developed 68 leaks. Was first told that the sealing looked good, but later investigation showed that we had no adhesion to speak of between the Viton compound and the titanium. This is a cruel blow, as it will delay us a month or more.' At last, in the 25 April entry, 'Went to the area and stayed overnight. Made our first flight under very different conditions.'

Oxcart chief test pilot Lou Schalk takes up the first flight story.

> It all went like a dream until I lifted off. Immediately after lift-off, I really didn't think I was going to be able to put the aircraft back on the ground safely because of lateral, directional and longitudinal oscillations. The aircraft was very difficult to handle, but I finally caught up with everything that was happening, got control back enough to set it back down, and to chop engine power. Touchdown was on the lakebed instead of the runway, creating a tremendous cloud of dust into which I disappeared entirely. The tower controllers were calling me to find out what was happening and I was answering, but the UHF antenna was located on the underside of the aircraft (for best transmission in flight) and

> no one could hear me. Finally, when I slowed down and started my turn on the lakebed and re-emerged from the dust cloud, everyone breathed a sigh of relief.

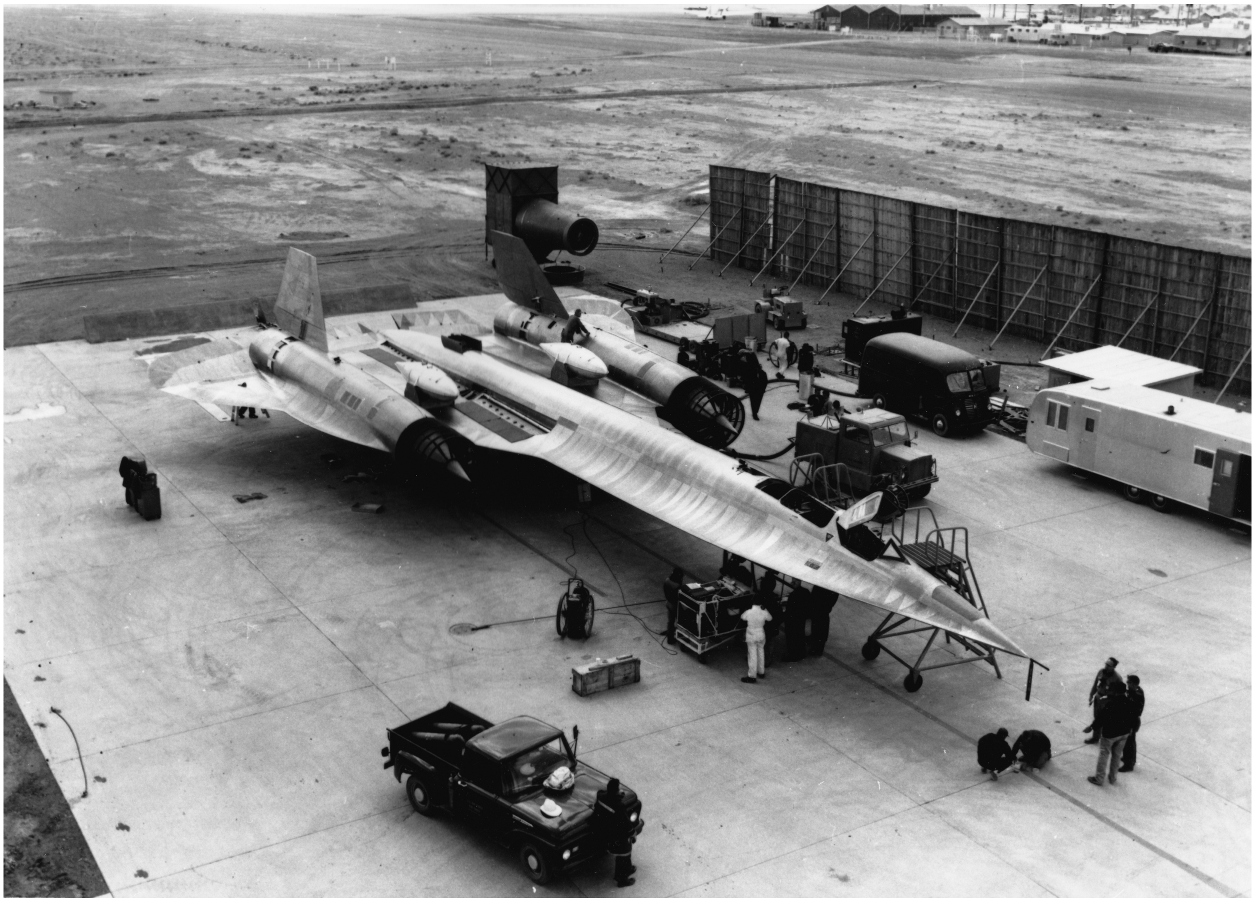
From the ground Kelly recorded.

> Flew about 1½ miles at altitudes of about 20ft. Aircraft got off the ground with lots of right rudder on, and then required change of rudder angle to 24° immediately. This set up lateral oscillations, which were horrible to see. We were concerned about the ability of Lou Schalk to stop, but he did this very nicely, without severe braking. The lake is soft enough so that we can roll onto it at fantastic speeds and stop readily. Actual trouble was later shown to be due to nose wheel steering problems.

It was decided to attempt another flight the next day, as Kelly noted.

> We rolled out early, and at 07:05 made a beautiful take-off. However, due to failure of a forward fillet bracket, we shed almost all the left-hand fillets and one from the right side, starting before we left the runway. Fortunately, I had spent the previous day with Lou Schalk, explaining that the fillets were non-structural and that we might have troubles. Beautiful landing was made, and in flight we investigated the effect of the stability augmenters. We showed that the first flight troubles were not caused by basic aircraft stability.

The first official flight took place four days later on 30 April 1962. During the 59-minute flight, the Oxcart (at 72,000lb gross weight) lifted off at 170kt. The landing gear was retracted and the aircraft climbed easily to 30,000ft, where it attained a top speed of 340kt. With the second flight test objectives achieved, the gear was extended and Lou brought the prototype safely back to roost. On 4 May, during a one-hour,10-minute flight, Schalk took 121 supersonic for the first time.



During the course of engine and fuel-flow tests serious leaks were discovered; external fuel tanks were used so that tests could continue. (Lockheed Martin)

When word of these initial successes were passed to Washington DC, John McCone, the new director of the CIA, telegrammed congratulations to Kelly, but the programme was a year behind schedule and much work still remained to prepare the new aircraft for its operational debut.

RECRUITING THE PILOTS

Despite issues arising from Powers' shootdown, CIA flight crew selection began in 1961, following a system developed by Col Houser Wilson (the Pentagon's Special Activities Office representative) and Brig Gen Jack Ledford (the Agency's USAF liaison officer, later succeeded by Brig Gen Paul Bacalis). Ken Collins, one of the first pilots recruited into Oxcart, recalls the process.

The primary professional selection criterion was that a pilot should have more than 1,000 hours in 'century' aircraft and a total of 2,000 flight hours. At the time, I was an experienced instructor pilot in the RF-101, having over 50 air-air refuelling training sorties and about ten transatlantic deployments, each with multiple air-air refuellings. This was the easy part of the Pentagon selection process. Either you had it or you didn't. All of your flight, professional and medical records were meticulously scrutinized at all levels before your name was released for further evaluation.

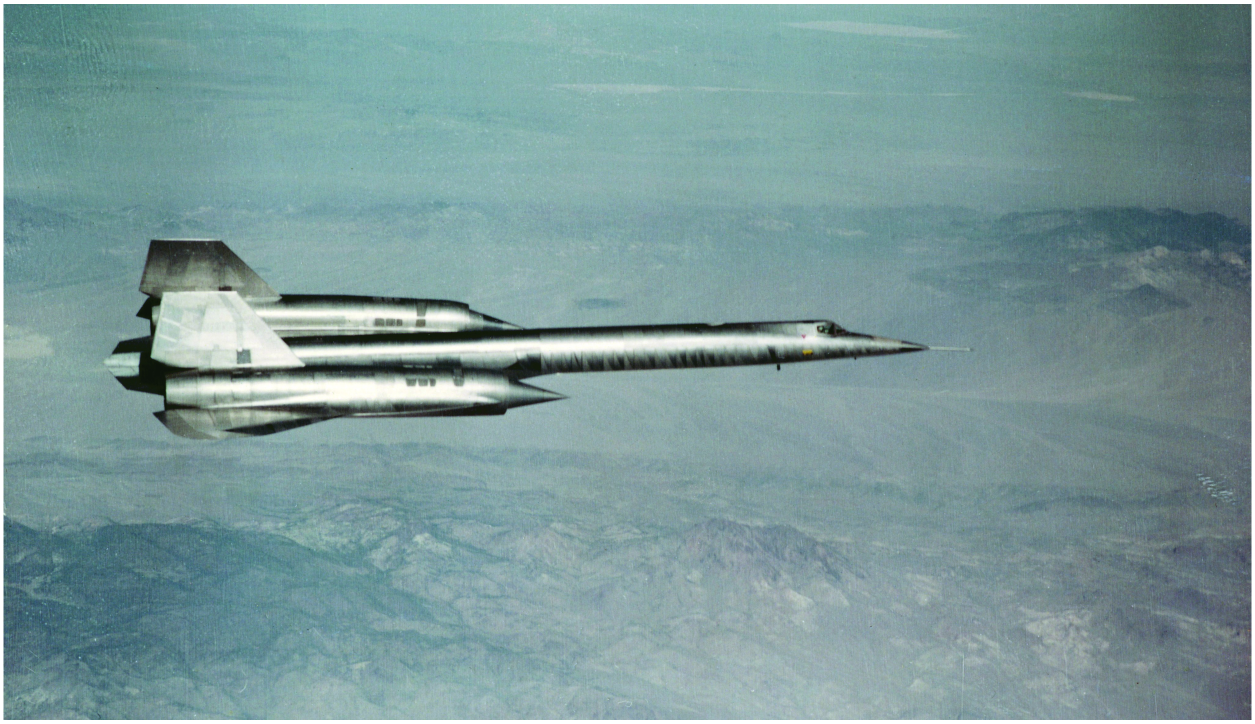
On the personal side of things, they were adamant that you were married, preferably with children – this was because they'd experienced problems with the previous U-2 programme. Their rationale was that the family unit was more socially established, dedicated and dependable. Later during the process our wives were interviewed and evaluated separately; expanded background investigations were also run on them. My wife Jane was told that she wasn't to talk to anyone about the interviews, neither was she told what I'd be doing. She could if asked say that I had decided to resign from the Air Force and work for Hughes Aircraft.

At this stage in the proceedings (April 1961), we didn't know what we were being evaluated for. Each of us was separately tasked for these various events. For example, I was unaware that another pilot from Shaw AFB, Capt Walter Ray, was also undergoing these interviews and evaluations. We started running into each other about a year later, when the field of consideration was narrowed by elimination. From day one you were given the option of withdrawing from the selection process at any time, without prejudice – an option that remained throughout the programme.

Our medical records were acceptable for the initial evaluation, because we were all on flying status; however, they weren't extensive enough as the selection process continued and we were all about to find out what that really meant. I was scheduled for my 'astronaut' physical examination at the Lovelace Clinic, in Albuquerque, New Mexico. This is the same facility in which the original astronauts and the early U-2 pilots received their medical evaluations. The clinic was founded by Dr Lovelace, one of the pioneers of aviation medicine and his work was continued by his son, Dr Randy Lovelace, until he, his wife and their pilot were killed in a flying accident.

My government contact at the clinic was an Air Force flight surgeon. He established my schedules and appointments and observed the tests; we also had dinner together, but this was more as part of the evaluation than being social. I arrived on a Sunday and departed the following Saturday; during those five days they checked out every bodily orifice, X-rayed me from head to toe, flushed me out and took samples and measurements of everything – I even had to carry a large brown bottle around for 48 hours to collect every drop of urine. They also conducted extensive EKGs and EEGs. I was hydrostatically weighed in a large water tank, ran the bicycle pulmonary functions and passed other physical stress exercises. They then flew me to Los Alamos Laboratory to be inserted into the 'body counter'. This mapped fat versus muscle tissue in the body and when correlated with the data from the hydrostatic weighing, it theoretically enabled them to determine total body capacity, regardless of size. After that I was ready for the hospital.

Lou Schalk (centre, in flight suit) is congratulated by Agency and Lockheed officials, following successful completion of the Oxcart's first 'official' flight on 30 April 1962. Note F-104 Starfighter in the background used by Jim Eastham as a chaseplane on the sortie. (Lockheed Martin)



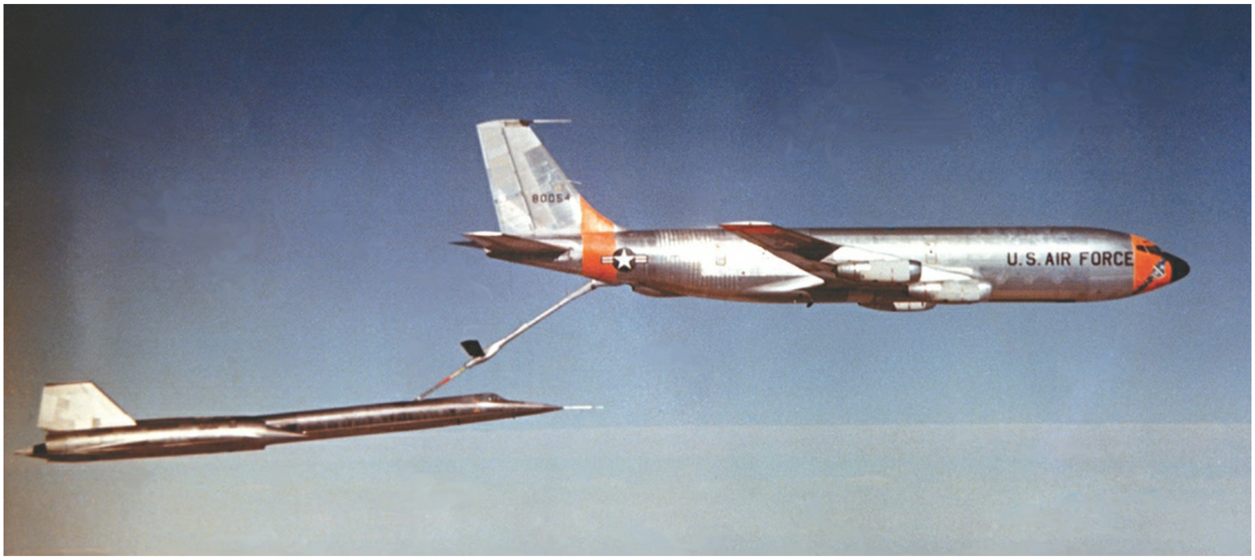
Article 121, up for a test flight on 10 July 1962. During the aircraft's second flight on 4 May 1962, it achieved Mach 1.1 at 40,000ft, despite being powered by two J75 engines. (Lockheed Martin)

I was also subjected to many different types of personal and professional evaluations. In Philadelphia, I was put into a soundproof black box, where I had to remain in total darkness and without sleep for 12 hours. Then there was a polygraph and numerous dinners and lunches with a variety of people with 'professional', medical, intelligence and senior manager backgrounds, all there

> to get an opinion. After all the sorting was nearly complete, I learned that eight people would be selected for the initial programme; this sounded reasonable, since that was the average group size for the astronaut programme.
>
> Finally, I received orders assigning me to Headquarters USAF, at the Pentagon, where I was to report on 28 October 1962. The packers had completed their task, but the night before Jane and I were due to leave Shaw AFB I received a phone call from Lt Col Clyde East, my squadron commander over at the 20th TRS, instructing me to report on base immediately, because the unit's RF-101s were on alert for immediate deployment to MacDill AFB, Florida, as what came to be the Cuban Missile Crisis had just erupted. I would have liked to deploy with my squadron, but clearly and unknown to them, other things were happening in my flying career.
>
> Having been informed earlier that my new assignment wasn't into the astronaut programme, but a project to fly and test an exotic new airplane for the CIA, I was again offered the option to withdraw; there were still no pictures of the aircraft or any other details, but I declined to opt out. On arrival in Washington I met other successful candidates that were soon to become close colleagues, Bill Skliar, Lon Walter and Walt Ray (who I already knew from Shaw). I signed on the dotted line and was told that I was to be in LA by November and that further contact and instructions would follow when I got there; so the next day Jane and I, together with our four kids, headed west.

In addition to Ken Collins, the other pilots that successfully completed the project's arduous selection process were Jack Layton, Dennis Sullivan, Mele Vojvodich, Jack Weeks, William Skliar, Walter Ray, Alonzo Walter, David Young and Russ Scott.

Frank Murray joined the programme via a more circuitous route. Graduating from the USAF Aviation Cadet Program as a pilot at Laredo AFB, Texas, in Class 53C (he completed the course in May 1953), he underwent gunnery training in the T-33 and F-84B and F-84C. He then went to France, completing his first operational tour with the 48th Fighter-Bomber Wing, flying the F-84G and F-86F, before returning to the United States to fly F-84Fs with SAC.



The first A-12 air refuelling was successfully achieved during 121's 24th flight, on 11 July 1962. (Lockheed Martin)

Bill Park was the second test pilot to fly the A-12; he's seen here later, during U-2R trials. (Lockheed Martin)

In early 1957, he was reassigned to another SAC wing, flying F-101As and Cs at Bergstrom AFB, Texas. In 1958 the wing disbanded and its aircraft were sent to the 81st Tactical Fighter Wing at RAF Bentwaters, England. Having recently returned from a tour of duty with United States Air Forces in Europe (USAFE), Frank was posted to the 60th Fighter Squadron, an Aerospace Defense Command unit based at Cape Cod, Massachusetts, that was about to re-equip with the new F-101B interceptor.

Cape Cod was Frank and his wife Stella's home for the next five years, at the end of which he volunteered to become a NASA support pilot. Little did he know that this was a cover used by the CIA to entice USAF fighter pilots to put their names forward, creating a list from which it could select pilots and support staff for the Oxcart programme.

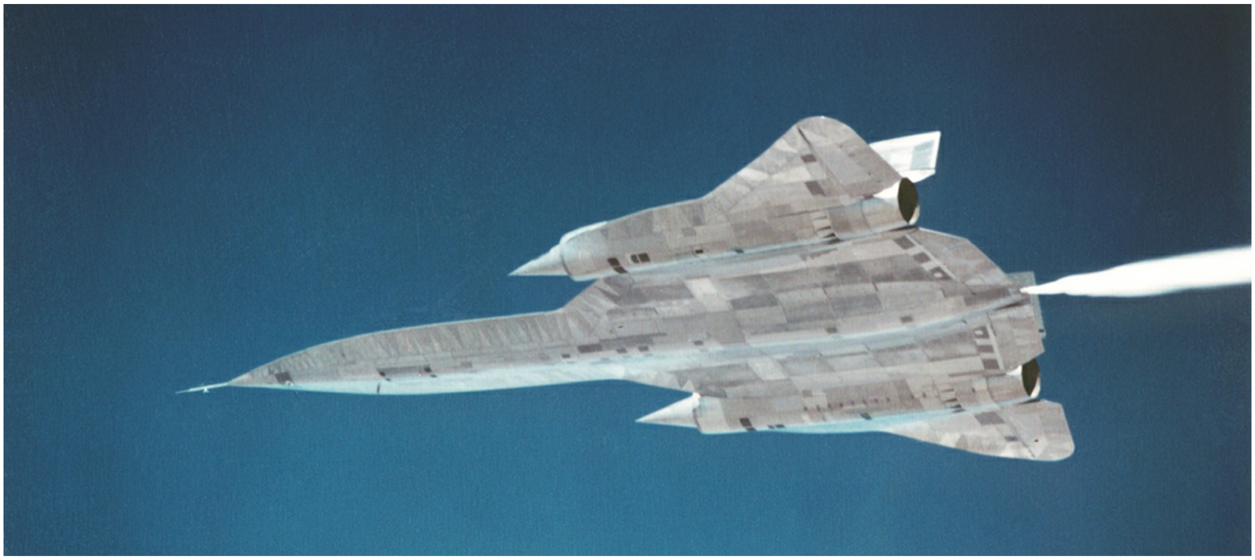
Like all those selected, Frank had an outstanding military record, with over 1,500 hours on the F-101 in his logbook. He arrived at Area 51 in July 1963 as an instructor and chase pilot in the F-101, checking out other pilots on the aircraft, conducting chase duties and performing routine proficiency and instrument flight checks. By 1965, some of the earlier Oxcart pilots had elected, for various reasons, to opt out of the programme. Frank was approached and asked if he was interested in becoming an A-12 driver. He leapt at the chance and became, as he puts it, the 'junior wienie!' Of the pilots on strength, only six would eventually take the Oxcart to war – Vojvodich, Weeks, Layton, Collins, Sullivan and Murray.

On 15 November 1961, Col Robert Holbury was appointed base commander of Area 51, as Watertown or The Ranch were more officially known. Other members of his staff included Col Doug Nelson, his Director of Operations (DO); Lt Col Anderson, Assistant DO; Lt Col Barrett, Chief of Base Operations and Chief of Standardisation and Evaluation (Stan/Eval); Lt Col Ray Hampt; and Maj Burgeson.

A-12 BUILD UP

On 6 July 1962, Kelly had at least put his overcrowding problem to rest when he noted: 'Opened our new engineering building, #311. This is the fifth Skunk Works building, and it is very nice.'

Lou Schalk had been contracted to perform the first 12 Oxcart experimental test flights, but an element of superstition led him to also fly the 13th, after which he was joined by another Lockheed test pilot, Bill Park. By the end of the July 1962, the prototype A-12 had completed its 28th sortie and flight test was proceeding well. Aircraft number two (Article 122) had arrived on 26 June, but was mounted on the pole at the Area 51 RatScat and although the first RCS test results were up 5 to 10dBs, this wasn't unexpected.



The bare metal finish of Article 121 shows to good effect the serrated edging applied to the fuselage and wing. It was filled with RAM on later aircraft. (Lockheed Martin)

With still no sign of the J58, the CIA became increasingly impatient to see progress in return for its Oxcart investment. Some senior Agency officials decided that the A-12 should be capable of Mach 2.0 with its twin J75 powerplant, since these were the engines that powered the USAF's Mach 2.0 Convair F-106 Delta Dart interceptor. They did not seem to understand that the A-12 had been designed to house a pair of J58s and that the J75s were mismatched with the inlet systems; this caused an inlet airflow vibration or 'duct-shudder' as Mach 2.0 was approached. However, in order to placate the directors who controlled the Agency's purse strings, Bill Park dived an A-12 to Mach 2.0, and this relieved at least some of the high-level pressure on the design team.

In July 1962, the J58 had finally completed its pre-flight rating test and the prototype was transported to Area 51. It was installed in Article 121's left nacelle, and until confidence levels in the new engine grew, the aircraft flew with a J75 in the right nacelle. But there were problems. One early hiccup was ignition – the engine simply would not start, no matter what procedure was tried by the Pratt & Whitney engineers.

The small inlet wind tunnel model had not revealed that the engine's appetite for air was so great that flow reversal occurred. Instead of flowing out of the compressor's fourth-stage bleed ducts, air was drawn into the compressor from the back end. As a temporary fix, Lockheed removed an inlet access panel to facilitate ground starts. It subsequently cut holes in the rear section of the nacelle and installed two sets of suck-in doors, while Pratt & Whitney added an 'engine bleed' to the nacelle to improve airflow through the powerplant during ground starts.

Having completed RCS ground trials in November 1962, Article 123 joined the flight test programme. Like its predecessor, ship two was initially equipped with J75s. (Lockheed Martin)

FIRST AIRCRAFT WITH
100 HOURS
123
APRIL 3rd 1963

Although slow to begin the test programme, Article 123 was the first A-12 to clock 100 hours, a total reached on 3 April 1963. Jim Eastham is sitting immediately behind the signboard in the centre; Dorsey Kammerer is rear row at far left. (Lockheed Martin)

Finally, on 5 October 1962, 121 flew with one of its new engines, but Kelly was not impressed, as he noted: 'It is down in thrust; fuel control is inconsistent;

there are thrust jumps at different throttle positions; and we have continual trouble with the afterburner lighting system and plugged spray bars.' On 16 August, Jim Eastham joined the flight test team and that same month aircraft three (Article 123) arrived at Area 51. It did not fly until October, a month that proved significant for Oxcart.

THE CUBAN MISSILE CRISIS

On 14 October 1962, Maj Steve Heyser's historic U-2 overflight of Cuba captured undeniable photographic evidence of the presence of Soviet SS-N-4 medium range ballistic missiles (MRBMs) and SS-N-5 intermediate range ballistic missiles (IRBMs) on the island. Consequently, U-2 overflights were increased to a peak level of five per day.

On Saturday 27 October 1962, Maj Rudolph Anderson was shot down by an SA-2 while flying a U-2 over Cuba. Once again the type's vulnerability had been demonstrated in most spectacular fashion. Anderson was killed in the shootdown, which served to reinvigorate the Oxcart programme; the achievement of operational status for the A-12 became a high national priority.

After completing more than 15,000 RCS tests, 122 was finally removed from the RatScat pole on 2 November 1962, and the results of its trials reviewed and passed by the CIA project office. Elsewhere, problems continued with P&W and Hamilton Standard, as Kelly wearily noted on 14 November: 'Deliveries were practically stopped by lack of Hamilton Standard fuel controls; the thrust of the engine is down, specific fuel consumption up. The initial engines would not run well above 75,000ft. They showed their programme for getting the performance back, but this could not be accomplished until engine #19, due for delivery in April 1963.' Aircraft five (Article 125) was delivered to Area 51 on 19 December, minus engines – but at least Lockheed met its schedule requirements for the year.

Aircraft four (Article 124) was the only two-seat pilot trainer and, like its stablemates, was due to be powered by J58s. However, given the ongoing engine shortage, it was decided to equip it with J75s throughout its lifetime. Once pilots had checked out, they would go on to high-Mach flight in a single-seater. Once this decision had been reached the aircraft (nicknamed 'the Titanium

Goose') undertook its maiden flight in January 1963.

Serial 60-6926 Article 123, over Sudan Crater. It was the first Oxcart lost crashing on 24 May 1963 after just 79 flights in 135.3 hours. Its CIA pilot Ken Collins ejected and escaped safely. (Lockheed Martin)

When some of the Agency pilots first saw the A-12 they were eager to confer a nickname upon Kelly's new Skunk Works masterpiece. Aware of Lockheed's penchant for christening its designs after celestial bodies, Jack Weeks came up with Cygnus (the Swan), the name of a constellation in the northern celestial hemisphere, lying between Pegasus and Draco in the Milky Way. The name was particularly apt for the secretive A-12 programme because research astronomers believe that Cygnus may contain one of the most mysterious of nature's invisible bodies – a black hole.

PALLADIUM

Concern was voiced in some quarters over the Oxcart's ability to avoid detection by Soviet radars. Under an ongoing effort to measure the range and power of various Soviet defence radar systems, the CIA implemented the Quality ELINT programme. A highly classified element of that programme was codenamed Palladium. Its objective was to determine the sensitivity of various Soviet radars.

To achieve this, a special electronic transmitter capable of projecting a 'ghost signal' onto a P-12 'Spoon Rest' surveillance and missile acquisition radar was developed. The knowledge gained from the Quality ELINT power and coverage measurements enabled technicians to simulate an aircraft of any RCS and 'fly it' along a path at a pre-determined speed and altitude. By electronically varying the size of the radar returns and enlisting the co-operation of the National Security Agency (NSA), which intercepted and decrypted the relevant communications channels, it was possible to determine a radar's sensitivity based upon which signals were being tracked.

During the Cuban Missile Crisis, the US intelligence community had monitored the construction of no fewer than 19 SA-2 SAM sites on the island and these provided the CIA, together with Oxcart planners, an ideal opportunity to determine the sensitivity of its associated radar receiver. One night, a US Navy destroyer equipped with a Palladium transmitter positioned itself beyond the detection range of a Soviet P-14 'Tall King' A-band early warning radar situated near Havana.

With its antenna protruding just above the horizon the destroyer produced a signal that appeared to be emanating from a US fighter out of Key West, making a high-speed dash towards the capital, Havana. At a predetermined time, a US Navy submarine surfaced near Havana Bay, just long enough to time-release a series of balloons carrying radar reflectors of varying sizes. The idea was that having detected the 'aircraft', the Soviets would switch on SA-2 target tracking radars in preparation for engaging the target.

Release of the balloons ahead of the 'target' would produce a number of returns, of which the smallest reported would present the highest level of radar sensitivity. The operation worked like clockwork. Cuban interceptors were also scrambled to hunt down the 'intruder', and when one of their pilots told his ground-controlled intercept (GCI) controller, that he had acquired the 'target' on his radar, the technician on the destroyer flicked a switch and the 'US fighter' disappeared.

After analysing the intelligence data collected from this operation and by other means, the CIA's OSI concluded that Soviet radar capability would indeed be able to track and 'lock on' to an Oxcart, despite the aircraft's radar attenuating design features. Despite these discouraging findings, flight testing continued.

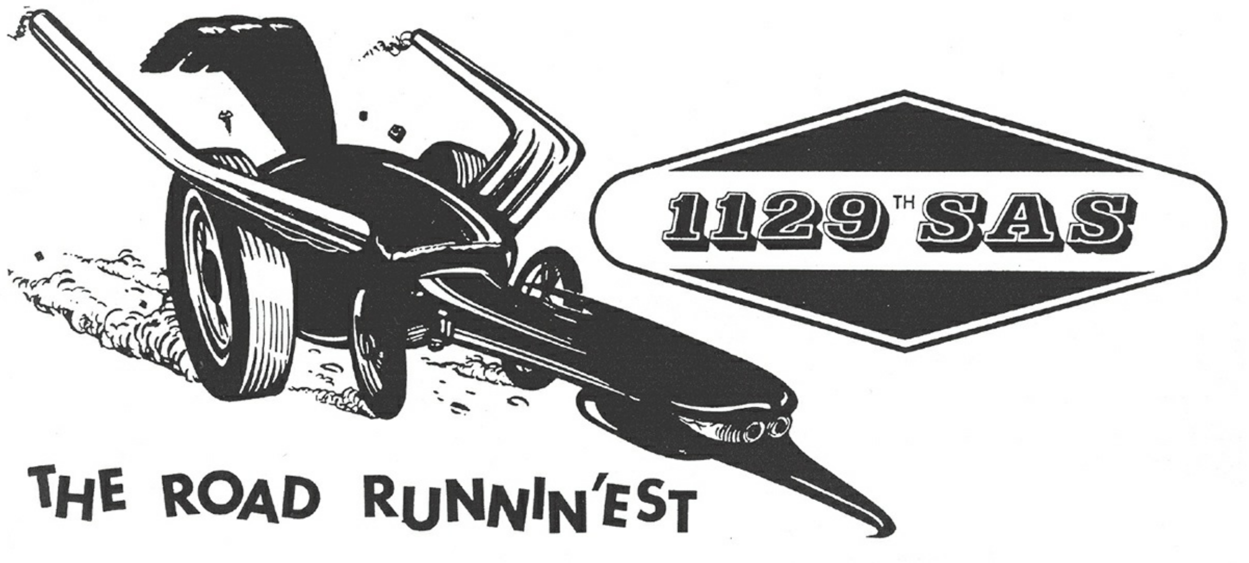
On 15 January 1963, Bob Gilliland became the fourth member of the Lockheed flight test team. That same day also marked the first time that an A-12 took to the air powered by two J58s. By the end of the month, ten J58s were available, but Kelly noted on 20 March: 'We have been to 2.5 Mach and as high as 70,000ft, but we are in trouble from Mach 2.0 up'. These J58 powered flight results were not at all encouraging for Lou Schalk, and he confided in Bill Park, who had chased him in an F-104, 'Look Bill, you're going to fly this airplane pretty soon, but don't say too much about how bad it accelerates, we're never gonna make Mach 3. But let's not get this programme cancelled 'til someone figures out how to make this thing run right.' After Park flew Article 121 equipped with the two J58s he said, 'Lou, you're right, but let's keep it under our hats.' Perhaps the two test pilots were joking, but there was clear cause for concern.

On 2 May 1963, Kelly went to Area 51 to investigate why it was proving so difficult to get past Mach 2.0. He wasn't impressed when he discovered the reason.

> It develops that Hamilton Standard had changed the gain on the spike control of the cam designed jointly by Rich and Hamilton Standard, and the main control contributed to the instability. Greatly displeased that Martin, Rich, Bohanan and Hamilton Standard could not find this out on their own, and no one seemed to know which controls gave which performance, until I made a review of the ships' records, and it became perfectly clear.

As the J58 flight test programme progressed, yet more issues surfaced. Heavy wear and cracks on the long drive shafts between the engine and its remote gearbox became a problem, together with twisting and heavy spline wear. This was caused by a 4in. displacement of the gearbox relative to the engine during high-Mach transients. A double universal joint on a new shaft between the two components solved that problem. It was also discovered that the fuel system ahead of the engine showed signs of fatigue and distortion. Measurements from a fast recorder showed that pressure levels at the engine fuel inlet were going off the scale. This over-pressuring was caused by feedback from the engine hydraulic system. The phenomenon had failed to materialize in rig tests and during engine ground tests because large fluid volumes were not involved.

Resourceful as ever, the Skunk Works invented a 'high temperature sponge' – promptly named the 'football' – that was installed ahead of the engines and reduced pressures to more tolerable levels. Yet another problem turned up during certain manoeuvres that crushed engine plumbing. This was found to be a result of the outer half of the nacelle rotating into the engine. Pratt & Whitney solved it by redesigning the rear engine mounting and incorporating a tangential link between the underside on the engine and the outboard side of the nacelle. A finite distance was thereby always maintained between engine and nacelle.



The CIA operational unit that flew the Oxcart was known as the 1129th Special Activities Squadron 'The Road Runners'. (CIA via Frank Murray)

As greater speeds and altitudes were attained, cockpit cooling became an issue. Bill Park recalled that the control stick got so hot that he had to change hands regularly to keep hold of it, even though he was wearing his pressure-suit gloves. In fact, temperatures got so high in the upper areas of the cockpit that temperature-sensitive material patches on the pilot's helmets were blackened, indicating that 130°F (54°C) had been reached. By redirecting the incoming flow from the AiResearch air conditioning unit and employing a special bootstrap-cooling unit, the Skunk Works eventually provided a tolerable cockpit environment.

PROJECT PILOT TRAINING

Ken Collins recalls his flight training for Oxcart:

I began flying training by rechecking-out in the F-101. Since I had already accumulated over 1,000 hours in the RF-101A, C and B (Trainer) as a combat-qualified crewmember and flight instructor less than three months before, this was achieved in short order. All flying was accomplished in accordance with current Air Force standardization and evaluation regulations.

The project pilots studied existing A-12 procedures documents, and reviewed the systems with aircraft systems engineers and the Lockheed test pilots: they also got all the cockpit familiarization time possible. It's important to point out that during these early days there was little in the way of established test data and procedures. Kelly Johnson repeatedly said that this was a truly experimental test program. The systems were new and untried, so changes evolved and were being made daily with the completion of each test flight. Procedures were developed in flight, and during the debriefings. Every flight was critically reviewed by the project pilots, the system engineering staff and the Lockheed test pilots.

A-12 flight training began with three or four flights in the AT-12 trainer, which was equipped with J75 engines and afterburners. The cockpit and flight systems were basically the same as other A-12s, but the trainer would only get out to Mach 2+. There was no flight simulator, so the trainer was the best available and it was good. My first A-12 trainer flight was on 6 February 1963. Bill Skliar was the first project pilot to fly the aircraft and he checked out two days earlier; Walt Ray followed me on 10 February and Lon Walter sometime after that – Lon opted out of the programme shortly after he started flying the J58 A-12. Take-offs and landings were very similar to the operational A-12, as was air refuelling. I wanted to ensure that I got all the trainer flight time possible in preparation for my first flight in the single-seater, equipped with J58 engines.

The most critical event that the trainer could not prepare you for was the inlet unstarts, because it didn't have a variable geometry inlet and could not get to Mach 3. Other important points at this juncture:

1. The A-12 did not have aft bypass doors;
2. Did not have spike and door position indicators;
3. Only had spike/door restart switches;
4. The fuel controls were unreliable;
5. The inlet controls were unreliable.

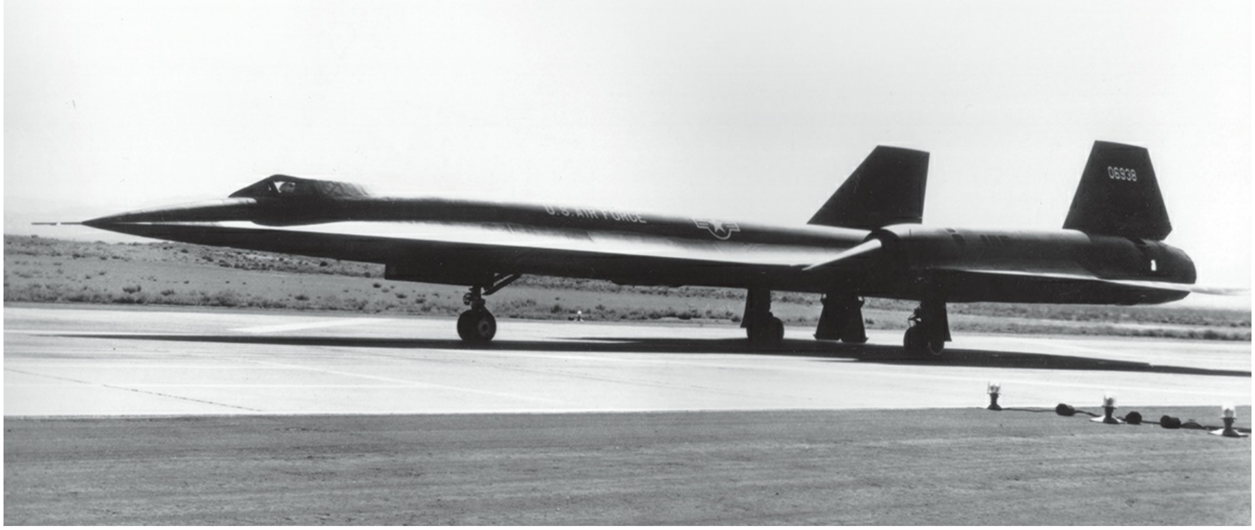
As soon as possible after the A-12 trainer checkout, we were put on the A-12 schedule. Once there, every flight was different, with the exception that every flight had multiple inlet unstarts. When you began the climb and acceleration out to 80,000ft and Mach 3, you were certain that there would be a 'popped shock' and an unstart between 2.5 Mach and 2.9 Mach. You never knew the extent of these. True to say, however, that all unstarts were severe and serious in the beginning. The problem was that since we only had a toggle switch for each inlet (no inlet position indicators until much later) we were reacting, usually too late, to an unstart that was already in progress. An inlet unstart 'popped' the shock out of the throat of the inlet, immediately stopping the airflow through that inlet and causing an engine compressor stall and afterburner blow-out, both of which were essential to your acceleration and retaining altitude.

At this phase of the test programme you were only guessing which system unstarted, left or right. For any hope of restarting the inlet and continued acceleration, you hit both inlet toggle switches immediately. By making a quick guess you reactivated that inlet toggle hoping that you could catch it before the unstart compressor stalled the engine and blew out the afterburner. Even after guessing

> right, you were usually too late, because it all happened in a nanosecond. After the unsuccessful attempt to get an immediate restart, you were in for head knocking, rapid deceleration and a shuttering dive toward the ground. At this point, you weren't concerned about the inlets, your primary efforts were directed toward getting the engine restarted, because the severity of the initial inlet unstart placed the aircraft in a hard yaw, which then caused the other inlet to unstart, which in turn caused that engine to compressor stall and the other afterburner to flame out, leaving you with an even more serious problem and very few options. You *had* to get at least one engine re-started. Reflecting back to those days, we always got at least one turning and burning again. The most serious problem occurred when the TEB [tri-ethyl borane] probes started 'cooking', which caused a chemical residue to build up on the engine/afterburner-starting TEB probe, restricting the flow of TEB, which was required to re-ignite the engine and/or the afterburner. We had a lot of other mechanical and electronic system problems throughout the programme, but none as big as the inlet unstarts.

Virtually all these training sorties required a fuel top-off shortly after take-off and the refuelling tracks, or anchors, were located within the Yuletide Special Rules Area (SRA), colloquially known as the Yuletide Special Operations Area (SOA), about 20 miles further north of the 'tunnel'. For missions planned to the north, the refuelling track was orientated on a north-south axis, for flights to the east or west, there was an east-west track. If weather within the SOA was not conducive to air refuelling, the 'Oxcarters' used SAC anchors. A track located to the north of Lake Tahoe in western Nevada was used on several occasions for weather avoidance.

The A-12 was refuelled at an altitude of 30,000ft (4–6,000ft higher than the SR-71, because it was lighter and carried less fuel). On completion of the air-refuelling task, the A-12 would turn onto its outbound course and carry out a climb/dive manoeuvre referred to by Oxcart pilots as a 'Whifferdill' and designed to accelerate the aircraft rapidly through Mach 1 in order to reduce transonic drag and the associated increased fuel consumption.



Article 132 in its all-black paint scheme with national insignia and US Air Force titles on the fuselage, despite it being a CIA aircraft. (Lockheed Martin)

The most frequently used track was that to the north. The main test-hop was known as the Wells Route. After air refuelling and completing the Whifferdill, the Oxcart headed directly for the small town of Wells, in northern Nevada. Climbing through 60,000ft, the pilot checked in with Salt Lake Center and informed them that he was above the SOA. Shortly after level-off at 75,000ft and the cruise-climb, the autopilot, coupled to the inertial navigation system (INS) rolled the aircraft into a left turn over the old mining village at Midas (about 50 miles north of Battle Mountain, Nevada); both Wells and Battle Mountain therefore received regular 'boomings'.

After passing over Area 51 on its return, the A-12 would complete a descending left turn to arrive back in the SOA for a let-down to base. A variation of this route extended beyond Area 51 before a wider left teardrop turn, followed by a deceleration into the SOA; this track enabled the aircraft to burn off more fuel and thereby achieve a much higher altitude. Both routes ultimately terminated in the SOA, from which point the aircraft proceeded either under, over or through the tunnel before landing back at 'home plate'.

To provide project pilots with the opportunity to experience an extended fight with multiple 'hot-legs' for 'graduation' or final flight training, a route was also established to the west. After completing the first air refuelling and hot-leg, the pilot descended for another top-off near Hawaii, before completing a second and final hot-leg back to the SOA. For the 'graduation' flight, the Stan/Eval section often planned the tanker in the Hawaiian anchor to be out of position in order to give the new pilot a chance to exercise the lost tanker drill. During his first attempt at this route, Frank Murray recalls having 'great fun' experiencing a severe unstart at about Mach 2.4 at 60,000ft on the climb-out. 'It was so severe that it broke the sunshade visor on my helmet and managed to break off one of the canopy-mounted, over-the-shoulder cameras. Needless to say, I didn't graduate that day and returned to base a very weary and sobered young aviator!'

There were also routes to the east, one involving a single top-off followed by an easterly hot-leg of about 800 miles before turning back home for a run over the base. Another easterly route was named Super Continental. It included a second air refuelling near the east coast before turning back and recovering into Area 51. Some of these training routes included the use of the aircraft's camera and EW systems. Area 51 was equipped with a variety of threat simulators that could trigger a response from various pieces of avionics for the purpose of testing both the equipment and pilot.

The AT-12 only flew within the SOA since with its less powerful J57s it could not fly it above the positively controlled areas. It flew practically every Monday night to keep the pilots current in night flying and night air refuelling.

F-101 CHASE DUTIES

All A-12 flights from the Area were assigned an F-101 chase. During the early years, many sorties were documented by a camera operator (frequently a Lockheed employee, sitting in the back seat of the F-101 with a movie camera). Once the number of sorties increased, photo-chase flights declined, however. Typically for these missions, the chase pilot attended the A-12 pre-flight briefing and was ready to roll shortly after the Oxcart's brake release. After reaching a few thousand feet and 350kt, the A-12 usually came out of afterburner and the F-101 joined in close formation for its pilot to look over the Article for signs of leaks, loose panels, etc.

Chase then flew a loose route formation while the A-12 proceeded to the refuelling track designated for that mission. Through this period the flight generally remained below 24,000ft until north of the Wilson Creek–Coaldale airway. Once clear, the Oxcart climbed to the pre-contact refuelling altitude and, following a final 'nod of the boom' from the boom operator, the A-12 closed on the tanker and boom contact completed the radio silent rendezvous. The entire operation was carefully monitored by the chase pilot and once the Oxcart had topped off, cleared the tanker and accelerated away, the chase aircraft could ease into position and replenish its own tanks.

The A-12's fuel burned without a problem in the F-101's engines, but was not reliably re-ignited by the aircraft's spark plug ignition system if an engine re-light sequence became necessary – as chase pilot Dick Roussell discovered one day while demonstrating an air-start to a passenger! As a rule, chase stayed with the tanker until it departed; occasionally, A-12 test sorties called for a second AR, in which case chase would again be in position to monitor the situation. All the project pilots and several of the military staff officers at Area 51 were qualified as chase pilots. In addition to the F-101, during the early years two F-104s provided by Lockheed were also used on high-speed chase duties to document A-12 flight tests.

Denny Sullivan recalls undertaking an early morning F-101 chase sortie:

> I chased Bill Park on a 6am routine non-refuelled test flight early on. As he accelerated, I got the '101 supersonic and stayed with him out to about Mach 1.3 or so. He then climbed and pulled away. But on this particular flight, while out at about 1.5 and climbing he suddenly came out of 'burner and turned back towards the Area. As I caught up with him, I asked 'What's the problem?' He answered, 'Aft bypass'. This was quite confusing, as the aft bypass doors on the engine didn't come into play at that speed. I later met him on the ground to talk over the flight. Turns out he aborted due to the need of a quick trip to the 'out-house'. It was either a case of abort the flight, or 'do it' in the pressure suit – it was probably one of the most expensive trips to a toilet on record.

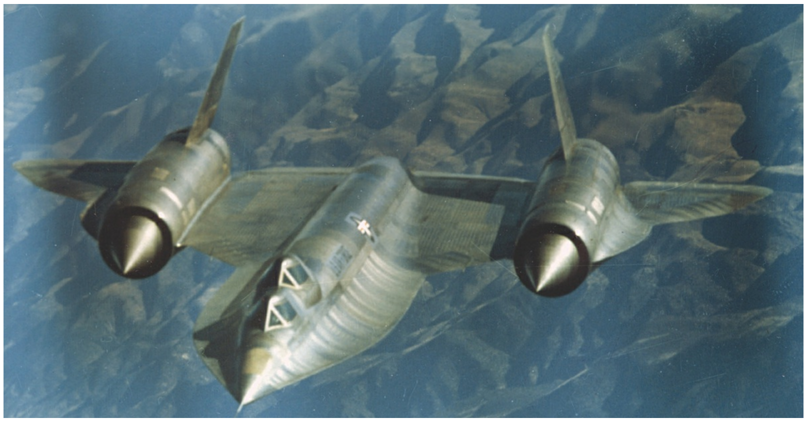
Heavy maintenance on the F-101s was conducted at Hill AFB, Utah. Staff and Oxcart project pilots were rostered to position the chase aircraft to Hill and collect and return them back to Area 51 as dictated by the maintenance cycle. To prevent identification of individual Oxcart crewmembers and avoid awkward questions being asked, they were issued with blue NASA flying suits and jackets. All carried DoD identification and official orders, which authorized the bearer to undertake such flights in the event that they were challenged, but the pilot's names were not displayed on any of their flight gear. Instead, a four-digit identity number was stencilled onto white tape that was sown inside their collars. These same numbers were stamped onto their pressure suits and helmets, and replicated across the top shelf of each pilot's cubicle in the personal equipment room back at Area 51. The base ops staff at Hill AFB were soon used to seeing flight plans filed by blue-suited pilots declaring their destination to be one of the many airfields within the Nellis area – which was more or less correct.

KELLY GOES SUPERSONIC

On 27 August 1963, Kelly Johnson made two flights in the AT-12, Article 124, to enable him to experience the platform's early performance. Lou Schalk was the 'instructor pilot' in the Titanium Goose and recalls one of them:

> I took off, cleaned it up then 'gave it' to Kelly. He climbed the airplane, levelled off with the afterburners in and accelerated out to Mach 1.4. That was the first time he had ever been supersonic and he was delighted.

On 27 August 1963 Kelly Johnson made two flights in the AT-12 'Tin Goose' trainer. It was the first time the Skunk Works boss had ever flown supersonically. (Lockheed Martin)



Seen from the tanker boom operator's position Article 124 was the only two-seat pilot trainer built.

Powered by J75s, it was restricted to 'low' Mach and 40,000ft, negating the need for crewmembers to wear a pressure suit. (Lockheed Martin)

> The airplane behaved beautifully as we proceeded to take an INS trip to one of our checkpoints on the course. I rolled the airplane into a steep bank and there was the checkpoint – a city down in Utah, right on the money. I then contacted the tanker for a refuelling rendezvous – which at times could be a bit 'hit and miss'. He answered my call immediately and was right where he said he was. I picked him out, slid into position and the boom operator, who was red hot that day, plugged me off and we'd taken on 5,000lb of fuel and were gone again before we hardly knew what had happened.
>
> Maybe it wasn't a good idea to have such a good flight with the Boss, on whom you were supposed to impress all the problems that you were having, but it was a beautiful flight and I'm sure glad he was there.

THE FIRST LOSS

As with most flight test programmes, success is scarcely obtained without loss and the first Oxcart crash occurred on 24 May 1963. The pilot Ken Collins was scheduled to complete two circuits of a pre-planned route in Visual Flight Rules (VFR), in Article 123, to test the Inertial Navigation System (INS) and Velocity/Height (V/H) sensors. Departure was originally set for 10:30am, but due to deteriorating weather conditions, this was brought forward to 10:00am. With a gross weight of 85,000lb (35,000lb of which was fuel), and the aircraft's centre of gravity set at 19.8 per cent, Collins was airborne at 09:57am using his personal, allocated Oxcart callsign, Dutch 26. Twenty seconds later, Capt Don Donohue released the brakes of his F-101 chase aircraft (callsign Boxer 11), and joined Collins at 28,000ft, about 30 miles from Area 51. Approaching Austin (one of the designated turn points), in order to stay clear of cloud they climbed to about 34,000ft, but according to Donohue, as they approached Wendover (the next turn point) conditions deteriorated further and at times they were flying according to Instrument Flight Rules (IFR). However, setting course for home plate (halfway through the test flight), and about 30 miles after passing Westover, they broke out of the cloud. At this point the relief chase F-101 (callsign Boxer 10) and flown by fellow Oxcart pilot Jack Weeks called in on the radio. Donohue told Weeks that 'we're conning real good [contrailling], if you want to descend before we go thru the airways.' Once established on-course for Austin on the second leg, Donohue called Weeks, telling him he would climb above the Oxcart to contrail level, so that he could visually acquire the A-12 more easily – the ‘handover’ worked, and Weeks in Boxer 10 was now flying chase.

In the accident report, Weeks said:

> At the time (about 11:50 L), I was in close formation, and we were just above an overcast at 34,000ft. Entry into the left turn at Westover seemed normal, except that at about one third of the way through, I started getting the warning horn [stall warning]. I told Collins that he was getting too slow for me and that I was sliding to the outside to gain airspeed. As the distance between us became greater, I intermittently lost sight of him due to the cirrus overcast. When we rolled out of the turn, I was slightly ahead and above the Oxcart and advised him that I was crossing in front of him and was climbing to stay VFR. At this time, he said his heading was 200° and that he saw me. I picked him up visually again and saw that he was straight and level. I told him that I would maintain heading and altitude and to keep me posted of any change of heading. It was planned to let him pass me up and then would re-join. Shortly after completing the roll out of turn, he said, ‘I think I am having airspeed trouble’. I asked him how serious and he gave no reply. I could intermittently see him in the top of the overcast and he appeared level and on a heading of 200°. After this I never did see his aircraft again. The time was 12:02L.

The following is taken from the after-accident report completed by Ken Collins the day after the accident.

> Prior to reaching the Wendover checkpoint I was at 34,000ft, indicating 0.85 Mach on the triple display indicator. Upon reading zero on the distance to go indicator (INS), I began a left turn in accordance with the pre-briefed flight plan. When approximately half way through the left turn I noticed the Mach dial increasing. I began a climb while in the turn; however, the airspeed and Mach number continued to increase. The maximum Mach was 1.05. I could not figure out why this should occur since the throttle settings had remained constant throughout the flight and I was climbing. While in the turn, my wing man Jack Weeks said that he could not keep the same rate of turn, therefore was making a larger turn. He said that he still had me in sight. During this time, I was flying the aircraft with the CSC stick button. After observing the increase in Mach and airspeed on the triple display indicator, I retarded the throttles slightly to see what effect this would have. I then levelled off in the top of the cirrus clouds and engaged the auto nav position of the INS. During this time the airspeed indication began to decrease. Assuming it was a temporary malfunction, I began checking my mission equipment and engine instruments. I checked the pitot heat switch which had been on during the entire flight, turning it on and off three times, then leaving it on. Mission equipment was operating satisfactory and the RPM read above 98%. I believe that the fuel flow was reading 1,800 pounds per engine. I am not positive of the above statement concerning the fuel flow nor as to when I observed this. After checking the mission equipment which required only a second or so, I immediately noticed the airspeed (KEAS) decreasing below cruise. About that time Weeks stated that he was passing me and I saw his contrail off my right although we were in the cirrus. When I observed the airspeed (KEAS) dropping below 160, I increased the nose down attitude of the aircraft with the auto pilot pitch control wheel. This was a small correction of the pitch control which would lower the nose slightly, not wanting to descend into more dense weather. The airspeed continued to decrease and upon reaching 147 KEAS, I utilized the CSC on the stick to increase the rate of descent attempting to increase the airspeed. I felt that it was not good procedure to get into an excessive rate of descent in the weather with the instruments being possibly unreliable. Also, the airspeed didn’t

improve directly with the rate of descent. I believed that the pitot system or the airspeed indicators were malfunctioning, therefore, I levelled off and engaged the auto nav switch of the auto pilot system hoping it would maintain level flight, if I was getting erroneous readings from the flight instruments. There was no improvement in the air speed – the indicator showed a continued decrease and I immediately disengaged the auto nav and flew with the CSC. I called Weeks my chase wing man, and told him that I was having air speed problems. During this period, I was gradually descending. At about 120 KEAS I again informed him that I was having troubles. When the air speed dropped to 101 KEAS the aircraft began to shudder and stall. I attempted to lower the nose with reference to the flight instruments, but the aircraft snapped two or three times and went into an inverted, flat spin at approximately 30,000ft. I informed Weeks that I was in a spin. After an unknown number of rotations, I would estimate 25,000ft, and after attempting to right the aircraft or gain control which was futile, I decided to eject. I looked down at the ejection handle, got a firm grip, tried to position my head in the head rest and pulled. I was in an inverted position, thus ejecting downward. The canopy and ejection seat apparently functioned properly. I felt the seat push away straps separate me from the seat and then the drogue chute deployed. At that time I checked my watch which read 12.05. Shortly after the drogue chute separated deploying the main chute. The main chute opening shock was moderate. With the survival kit to sit on I was quite comfortable. At exactly eight minutes after I checked my watch (12.13), I pulled the survival kit release, the kit dropping to the length of the lanyard throwing off the cushion. The kit then began rotating, which I tried to diminish with my feet attempting to dampen the oscillations. I retained my helmet, having the mask snug and the visor down. The visor fogged up and I could not see, so I raised it. As I descended, I saw the ejection seat pass me, then I saw the aircraft below which appeared to still be in an inverted, flat spin. I saw the aircraft again after it had hit [the ground] and was burning. When the survival kit made contact with the ground, I prepared myself for the touch-down. I landed on my feet, falling to the left on my back and left shoulder I tried to unlatch the right riser release to collapse the chute, because of the wind, [but the] latch was too hard to open. I then released the left riser release and removed the parachute harness and collected the chute. I had landed about one and a half to two miles from the aircraft, but could only see the smoke. Making two trips to another hill, I moved all of my gear in an effort to get nearer to the aircraft. I was going to pick up the drogue chute which was about 2,000ft from me. I saw a red pick-up with its lights on. Not being certain that they had seen me, I walked back to the first hill where they saw me. There were four men in the truck. They said that they were on the highway and saw me in the chute. They travelled over very rough ground to pick me up. Enroute, they had found the ejection seat which they had in the truck bed. They put my gear into the truck, and retrieved the drogue chute. We then drove to the highway where we saw Deputy Sheriff Ed Boyce. We transferred all the gear except the ejection seat to his station wagon.

POST SCRIPT

Ken Collins continued in an interview with the author:

An intense accident investigation was conducted. I submitted to sodium pentothal to confirm all my statements relating to the flight and the accident. The person who solved the true technical causes of the accident (inadequate pitot tube design had caused the air data computer to fail, an issue solved when the Rosemont Probe was introduced) was Norm Nelson. A dedicated government engineer and a fine, caring man, who later became vice president of the Skunk Works. As always, the initial belief is that there was pilot error, but fortunately the real causes of the accident were discovered and corrected.

> Ten years after the accident, I received a package in the mail. Unwrapping it, I found a shadow-box frame with the 'D' ring mounted inside with the inscription to Ken Collins 'A Friend In Need'. It was my ejection 'D' ring from the A-12 and was sent to me by Keith Beswick, a Lockheed engineer on the Oxcart programme.

The wreckage of Article 123 was recovered in two days and persons at the scene were identified and requested to sign secrecy agreements; interestingly, the press cover story describing the accident as having occurred to an F-105 still remains listed this way on official records. The fact that the Oxcart was on a 'low' altitude sortie and that Ken was therefore not wearing his 'moon suit' gave further credence to the story.

In an ironic twist of fate, sometime after the loss of Article 123, an F-105 from Nellis *was* lost and members of the Oxcart programme were involved in the search for the crash site. Frank Murray recalls:

> Earlier in the day, four of the big Republic aircraft had taken off for a sortie in the Pahrump Valley area, west of Spring Mountains, near Las Vegas. After some in-trail formation aerobatics, the flight was minus number four.
>
> The command post at Area 51 ordered both the base helicopter and Cessna 210 to help in the search. One of the flight surgeons, Roger Anderson and I, got airborne in the Cessna and set up a search pattern in the southern half of the valley 1,000ft above ground level on an east-west track. We soon located the crash site near a small lake adjoining the property of one of the brothels in the area, known as Ash Meadows Ranch. From the air, it appeared that the F-105 had impacted the ground, wings level in a slight dive. Marks on the ground were consistent with where first the drop tanks and then the tailpipe contacted before breaking up.
>
> The brothel provided a small dirt runway, graded out, to allow its customers the option of air travel into the facility. Our party, attired in Air Force flight gear, landed and taxied to the main building where we were greeted by a gent. We explained that we were part of a search party and that we'd located a crash site and requested transport to check for possible survivors. He was happy to oblige and we were driven the few miles in the Ranch van and upon reaching the site the flight surgeon confirmed that the pilot had perished in the accident.
>
> At about this time a chopper from Indian Springs arrived at the site and I provided the crew with a brief written report and returned to Ash Meadows. By now it was lunchtime and the madam had got the cook to rustle up lunch. During the course of a rather guarded but polite conversation with the madam, my aviation curiosity got the better of me and I asked her what was the largest aircraft ever to use the landing strip; she replied that light twins were regular visitors, but the largest was an Army C-7A Caribou packed full with GIs from an Army base in California. 'Mind you,' she added mischievously, 'they weren't looking for downed airplanes!' After lunch the three of us said our goodbyes and departed for life back at our own 'Ranch'.
>
> As a final footnote to Ash Meadows Ranch, one of the 'lovelies' discovered that a resident, who never actually 'indulged' himself, seemed to have a rather questionable background: further suspicions prompted the madam to notify the FBI. Slip Slater recalls being subsequently briefed by Nick Zubon, the Area 51 resident Agency chief of security, and it turned out that the individual in question turned out to be a ship's radio operator from an Eastern Bloc country. Following a raid on his room, an array

> of hi-tech communications equipment was discovered! It spelled the end of his days in espionage, but to date, no one actually seems to know who he was or what subsequently happened to him.

DESIGN SPEED – AT LAST!

On 24 June 1963, Kelly noted, 'During this month we have tried to pick up in our airspeed/altitude profile. Have not gotten much, due to voluntary grounding during #123 investigation and terrific troubles with Ham Standard spike control.'

Regulation of airflow within the air induction system was critical to the Oxcart achieving its design cruise speed of Mach 3.2. To achieve this, the inlet spike's aft-movement schedule had to be programmed very accurately as speed increased; the same accuracy applied to the position of various bypass doors. Once the fine-tuned control of the high-speed inlet/drag equation had been achieved, it was reasonably anticipated that fuel consumption would reduce significantly and the aircraft hit the design numbers. A couple of weeks later, Kelly wrote, 'Having difficulty in getting aircraft to speed, because of inlet problems. Do not know whether it is an aircraft, engine, or inlet control problem.'

Finally, on 20 July 1963, Article 121 reached Mach 3.0. However, while flying the same aircraft on a second attempt, Lou Schalk experienced what he described as perhaps the most 'thrilling' flight of his test flight career.

> I was approaching Wendover, Utah, from the south and the aircraft was accelerating like it had never done before. It was apparent that I would be at Mach 3 before I left Utah (well before reaching the turn point short of the Canadian border), so I throttled back and started my turn early. Emerging from the turn, I pushed the throttles to full 'burner and continued to climb. I got so far behind the aircraft that I didn't notice that the fuel flow fell off slightly, which led to a loss in rpm on one engine. The next thing I knew, I had an unstart, whereupon I attempted to open the bypass doors to break the unstart, but that action didn't seem to help. Then the other inlet unstarted and so it went on with terrific oscillations continuing, one after another.
>
> I made a single radio transmission saying that I was in real trouble. I thought I ought to bail out, but stayed with the aircraft because it still seemed to be in one piece and still flying, although these violent oscillations continued all the way down to Mach 1.4. I then realized that I'd left the right engine in 'burner and that the left engine had flamed out. I was holding tremendous rudder pressure with one leg in an attempt to fly straight without even trimming out some of that pressure with the rudder trim switch. When I finally came out of afterburner it was much easier to handle, so I restarted the flamed-out engine and headed back to base.
>
> At the debriefing I learned that the engineers had decided at their Monday morning maintenance planning briefing that the slow acceleration and high fuel consumption could be due to the bypass

> doors leaking air after they had closed. They therefore decided to 'bolt' them closed, but no one had told me about this decision and that's why the aircraft had taken off on me like 'a scorched dog'. It then also became clear why I couldn't break the unstart and why, when I tried to switch the bypass doors open, nothing happened to change the inlet airflow. After the lesson in lack of communication between engineers and pilots, I attended all the Monday morning maintenance planning briefings!

Kelly noted in his diary: 'On the second flight, we blew an engine at design speed. It was very difficult to slow down and it rattled Lou Schalk around for three minutes. The aircraft stability augmentation system did precisely as I asked it to do three years ago and no high structural loads were obtained.'

These envelope expansion flights from Area 51 trod a well-worn path across the emptiness of Nevada, northward over Wendover, Utah, high across southern Idaho and then turned east or west along a smooth 180° arc just short of the Canadian border, before heading back south toward Arizona or California and finally back down into the 'roost', north of Las Vegas. Sonic booms were heard all over the western United States and complaints were conveniently shifted toward the Arizona Air National Guard Fighters at Phoenix, then onward to the naval aviators at Fallon, Nevada and then onward still, towards any flying outfit capable of booming, this convenient shifting of blame being ignored by the 'Oxcarters' and Federal Aviation Administration (FAA) controllers who knew the truth. During the return leg to Las Vegas, the A-12 would reach its test-point objectives above 72,000ft, an altitude that would also allow the pilot to make a steep but safe recovery back to the 'Ranch' in the event of an inflight emergency.

The cockpit workload during A-12 test flying was extremely high, partly because the turbine inlet temperature (TIT) tended to wander. This variation needed close monitoring if engine damage was to be avoided. At 7,300rpm, unstable temperatures caused thrust variations, so two toggle switches were introduced to allow the pilot to 'trim' the fuel flow in small increments, without having to adjust the throttle positions, to keep turbine temperatures within operable limits. Two rotating wafer switches controlled the inlet spike position (forward and aft), while a third set varied the bypass door positions (open to closed). The task of flying the aircraft while manually operating those six control switches and determining the optimum inlet schedule of door and spike positions created a situation where the pilot was saturated with switch movement activity during acceleration to high Mach.

It was soon realized that it would be near impossible to fly the aircraft during unstable situations without the stability augmentation system (SAS) operating. This gyro-stabilized system, coupled into the autopilot, made life in the cockpit more tolerable, despite the disheartening effect it had of causing more than a third of the total fuel load to be used during the acceleration to full speed due to poor inlet scheduling. The slow initial progression 'to full speed' was the result of a trial-and-error positioning of door and spike inlet schedules.

During these early tests, speed was gently increased by one tenth of a Mach number before the next spike progression increment was selected. If all worked well, that day's work was analysed in the labs and incorporated into the schedule. More often, however, the spike position would not match the inlet duct requirements and a hard unstart (the violent, sudden expulsion of the normal shock wave from the internal throat of the inlet to its outside) would cause a harsh yaw movement, which swung the nose sharply in the direction of the unstarted inlet, snapping the pilot's head quickly to one side in the process.

To break a sustained unstart and recapture the disturbed inlet shock wave, the pilot would have to open the bypass doors on the unstarted side and move the spike fully forward, before slowly returning them to the smooth-flowing, but less efficient position they had occupied prior to the disturbance. Incessant problems in the air induction system caused Lockheed's propulsion engineers to change the inlet geometry and trim schedules. In addition, the manual trim schedule was speeded up to allow the aircraft to be accelerated more quickly and save fuel during the climb to high altitude.

During that first year of development testing, the inlet control schedule was changed often, and on many flights the two inlets never seemed to work together. Project pilot Walt Ray (wearing a Beatles' wig), after returning from a night training sortie filled with many unstarts, joked to the debriefing team at Area 51, 'Man, that was a hairy flight!' Unstarts came to be expected on almost all the early A-12 flights.

On 8 November 1963, Kelly was more upbeat when he noted, 'Today we flew the mice installation, to change the subsonic diffusion angles in the duct. This change corrected the roughness encountered at Mach 2.4 up, and it is the first major improvement in the duct.' (The 'mice' were protuberances installed in the air inlet, where they modified airflow distribution.) However, on 19 December he wrote, 'Still having trouble with Hamilton Standard on inlet controls.'

Painful though it was, progress was moving in the right direction and on 3

February 1964 Kelly wrote, 'Jim Eastham took '121 to Mach 3.3, with 15 minutes at Mach 3.2 or above. It singed our old tank-sealing compound, but was a very good flight. I am building up a variable bypass area at the face of the engine and have re-faired the upper outboard quadrant to get improved airflow distribution at high Mach number. At about this time, we flew #122 for 53 minutes at M2.65 or above.' In all, it took 66 flights to push the speed envelope out from a marginal Mach 2.2 to Mach 3.2.

Bill Skliar took part in the A-12 flight test programme but returned to the US Air Force before the aircraft was deployed operationally, where he continued his flight test career on the SR-71. (Lockheed Martin)

MORE TESTING, MORE LOSSES

On 9 July 1964, after a ground roll of 7,400ft and on reaching 210kt, Bill Park was airborne from Area 51 at 08:20am local time in Article 133. The test card called for a maximum afterburner climb at Mach 2.8 to 78,000ft on the Copper Bravo route. He was chased through the lower Mach numbers by Col Holbury and Capt Roussell flying an F-101. At the northern end of his route, Park initiated a left turn onto the southbound leg, but suffered a left engine unstart and simultaneously lost the SAS's 'A-channel', which controlled yaw. Recovering from the unstart, Park accelerated back to Mach 2.8 and headed for home with both engines functioning smoothly, but with the 'A' yaw SAS still down.

Having decelerated and descended to 28,000ft in the vicinity of Area 51, he was re-joined by the chase aircraft. Adopting a high approach profile, Park was at 16,000ft downwind and 12,000ft base leg before rolling right onto final. He maintained 200kt and continued his descent for about a mile, but when the aircraft was at about 500ft it began a smooth, steady roll to the left. Park applied full right elevon to counteract the roll and increased power, but 133 continued its left roll. At about 45° and 200ft Park ejected. The aircraft continued its left roll, struck the ground inverted and exploded in a spectacular fireball. After just one quick swing under the rapidly deployed canopy of his parachute, Park's feet hit the overrun to runway 32. He'd had a very narrow escape but was uninjured.

POST SCRIPT

The accident investigation was initially hampered since the data stored in the flight recorder was lost when it was destroyed in the crash. But the team's diligence was able to establish that the accident was caused by the outboard elevon servo valve becoming stuck in the partially open position, causing the right outboard elevon to gradually move to fully down. This imparted more left roll to the aircraft than could be corrected by the pilot.

The valve had failed due to warping through a temperature shock condition induced during the rapid change of flight condition (the fast descent from high to low altitude), and metal particles within the servo valve that probably accumulated during its manufacture. As a result, design of the valve was changed and the servo assemblies subjected to a temperature shock environment to reduce the possibility of binding. In addition, the flight recorder system was replaced by a more modern robust system capable of withstanding crash damage. Finally, the board recommended that in future all A-12 take-offs and landings from Area 51 be filmed – a recommendation that proved particularly useful just five months later.

The accident investigation board examining the loss of 133 gave a useful insight into the intensity of Oxcart test flying at the time. It recorded that at the time of the accident, Bill Park had accumulated 148 hours on type, 39 of them in the last six months, and that he'd completed 6 hours 15 minutes in the last 30 days in 11 flights (thus the average flight time during the envelope expansion phase of testing was just 34 minutes).

August 1964 was yet another busy month for the Skunk Works boss:

> We are going forward with maximum energy to provide four operational airplanes with limited capability to fly over Cuba on Nov. 5th. We have been told by the Soviets that immediately after the [US presidential] election they intend to shoot down every U-2, which we are operating at a rate of 18 sorties per month. Should this be done, we would be unable to find out whether they put missiles

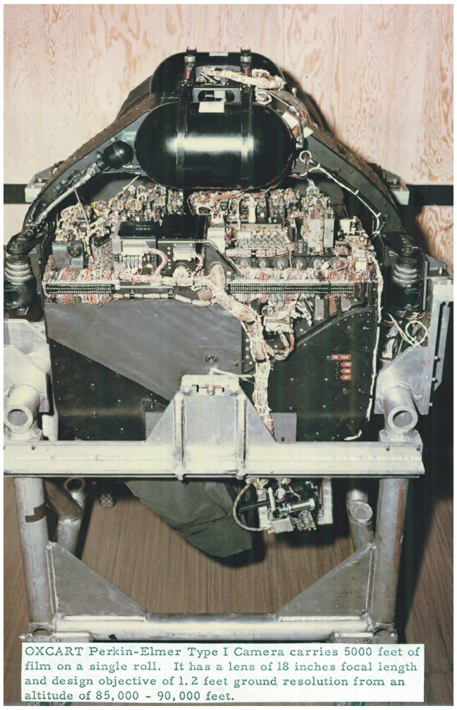
> back in; so the A-12 is vital for this purpose [this became Project Skylark]… Flew airplane #129 with J engines [Johnson's nomenclature for uprated engines that increased available thrust from 29,500 to 32,500lb] and afterburners. It has the best acceleration of any to date and it looks quite promising. However, we lost one engine, due to FOD [foreign object damage], from some source as yet underdetermined.

September 1964 was the month that Kelly Johnson was recognized for the enormous contribution he'd made to aeronautical engineering through the Oxcart programme, despite the fact that many of its details would remain classified for decades to come. On 11 September he received the Theodor Von Karman Trophy from the Air Force Association for the 'A-11'. Three days later he received the Presidential Medal of Freedom from President Johnson at the White House. On 24 September he was back at the White House, this time to receive the Collier Trophy. Two days later, it was the turn of his A-12 test pilots when Lou Schalk (who had by this time left Lockheed), Bill Park, Jim Eastham and Bob Gilliland were awarded outstanding achievement awards for 1963 from the Society of Experimental Test Pilots.

In December 1964, Kelly noted that: 'By using 450kt vs 400kt EAS [equivalent airspeed] in climb, we have overcome transonic problems. We are trying to get #129 in shape for a long flight, but are having continual engine problems on compressor discs, blade cracking, etc; so not flying much.'

Pneumatic pressure gauges were installed on the inlet systems to sense pressure variations of as little as ¼psi. Inlet spike position was based on a schedule derived from their readings. But it had become increasingly apparent that these pneumatic instruments were not sensitive enough for the job of accurately scheduling the spikes. Therefore, on 18 March 1965, Kelly wrote in his diary, 'On this date I sent Hamilton Standard a letter saying that we could not continue trying to develop the AIC-10 inlet control. We have spent $17,000,000 on the thing to this point, but it just will not do the job and is totally unpredictable.'

Aircraft were coming off the production line with the pneumatic system installed, but Kelly decided that it should be replaced by an electronically controlled system manufactured by the Garrett Corporation, even though thermodynamic considerations had minimized the number of electrical systems used in the A-12. Initially it required far more maintenance per flight hour than the pneumatic system, but its inflight performance was far superior to the old equipment. Despite the added cost, the electrical system was retrofitted to all aircraft already delivered and incorporated in the A-12s being produced at Burbank from aircraft number 9 onwards. On 14 May 1965, Kelly noted, ‘Hamilton Standard withdrawing a number of their people. Our long battle with them is coming to a sorry end.’



OXCART Perkin-Elmer Type I Camera carries 5000 feet of film on a single roll. It has a lens of 18 inches focal length and design objective of 1.2 feet ground resolution from an altitude of 85,000 - 90,000 feet.

In the words of one senior intelligence officer, without the Perkin-Elmer Type 1 camera, the A-12 would ‘just be burning expensive holes in the sky!’ (CIA)

Before the new spike control system was flight trialled, many electromagnetic induction (EMI) tests were carried out on the ground to ensure non-interfering operations. It was thought ‘all was well’ until a radio check made the inlet spikes retract! Back to the drawing board and more tests. When Bill Park briefed the other pilots about the new system, he added that unstarts would soon be almost a thing of the past. None believed him, but the new system immediately began to prove its worth and the number of unstarts reduced dramatically. Fuel consumption also decreased significantly due to the tighter inlet spike and door scheduling. On 21 June 1965, after a long, hard test career, 121 was transported back to Burbank to be brought up to date with a series of modifications.

SCOTCH MIST

Talk of possible operational deployments abroad spurred preparations to ready the aircraft. In September 1965, it was decided to flight test a windshield rain-clearing system, developed to enable the pilot to maintain forward visual contact with the ground during descent in heavy rain. The project, codenamed Scotch Mist, would also examine the flight characteristics of an Oxcart operating at sea level – the A-12 had only ever been flown routinely out of Area 51, which was well above sea level.

It was decided that the tests would be conducted from McCoy AFB, near Orlando, Florida, since its meteorological conditions were similar to those expected at Kadena AB on the Japanese island of Okinawa – a possible deployment destination. An A-12, with support provided by an F-101 and Area 51's C-130, was sent to Florida, along with pilot Walt Ray.

McCoy was a joint-use Air Force/civil airport, and at the time few people directly outside the Oxcart programme had seen the A-12, as Slip Slater relates:

> When the bird rolled out for take-off, no one had ever seen a 'Blackbird' and you could almost see the airliners tip as the passengers rushed to the side windows to get a peek! Another interesting event occurred on the first few attempts to get the machine airborne. Walt would get to the end of the runway for take-off and when he came back on the throttle, the engine would quit! Well, that brought a rash of P&W, Lockheed and United Aircraft [fuel control] guys out from Connecticut to identify and rectify the problem. They discovered that the T-2 sensor in the engine nacelle had to be repositioned – that cured it.

The rain clearance system was tested by flying the aircraft through local showers. A switch activated in the cockpit caused a chemical water wetting agent to be sprayed from nozzles located along the 'barracuda blade' (situated at the apex of the windscreen) to dissipate raindrops. To date, records commenting on the effectiveness or otherwise of the system remain elusive, however, Frank Murray recalls using the system once 'in anger', having returned to Kadena after completing an operational mission.

> It was 'raining like a dog', Denny Sullivan was out at the mobile and I recall thinking, 'Here's a great chance to try the vaunted rain-clear system'. I told Denny, but when I activated the switch, the stuff came out as white as milk and I couldn't see a thing through the windshield. Denny helped me by saying 'Okay, get the 'chute, get the 'chute!' He was saying for me to deploy the drag-chute… I could only see the sides of the runway. So much for the rain clear-system! Turns out the fluid had to be changed regularly and not kept indefinitely, since it coagulated from the heat accumulated during

cruise.

ARTICLE 126 IS LOST

On 28 December 1965, Mele Vojvodich was scheduled to fly Article 126 on a performance check flight, which included a rendezvous beacon test with a KC-135 tanker. During the Before Take-off check list, he encountered a compressor stall while trimming the left engine, which he down-trimmed slightly to correct the condition. With all checks now successfully completed, the aircraft was cleared for take-off and began to roll at 12:54pm local time. At a gross weight of 118,300lbs, the aircraft's centre of gravity was set at 20.9 per cent; the take-off distance was computed as 6,800ft. At 190kt Vojvodich began to rotate the aircraft and at about 210kt, Article 126 lifted off. Immediately after the main gear left the ground, the aircraft yawed to the left, followed by a pitch-up manoeuvre. In short succession, a series of violent yawing and pitching gyrations followed, as the aircraft became completely uncontrollable. The rash of Vojvodich's instinctive control responses were met by a series of counter-movements, opposite to those an experienced pilot would expect. It was indeed a pilot's worst nightmare. In the midst of this wild pitching and yawing, at between just 150–200ft off the ground and with fractions of a second to spare, Vojvodich pulled the D-ring between his legs, just as '126 reached the top of its final pitch-up'. Blasting free from his unmanageable 'bucking bronco ride', the aircraft pitched violently down and crashed. Impacting first on its left wing, '126 disintegrated as it slid across the frozen lake bed for about a mile in a 300-foot-wide path'. Vojvodich landed to the left of the aircraft's wreckage and was lucky to receive just minor injuries. The entire incident was filmed by Keith Beswick, one of Lockheed's flight test engineers (this wouldn't be the only loss of a Blackbird that Beswick would film).

POST SCRIPT

The subsequent accident board soon established that the cause was in the maintenance and material field. Further investigation confirmed that the rate gyro wiring harness had been installed incorrectly. Vojvodich and two other Oxcart pilots accomplished a series of test take-off runs in the SR-71 flight simulator at Beale AFB, during which the yaw and pitch rate gyro functions to the Stability Augmentation System (SAS) were reversed. These tests proved conclusively that ’126 was completely uncontrollable in these malfunction conditions and that the gyrations experienced in the simulator were practically identical to those that Vojvodich encountered just before the crash – it was thought nothing short of ‘miraculous’ that he had been able to escape with his life. The result of the SAS pitch gyros being connected to the yaw servos and vice versa meant that the aircraft had no stability augmentation in the pitch and yaw axis. Furthermore, an input into one axis induced a command into the other axis. Therefore, Pitch Up commanded Left Yaw, Pitch Down commanded Right Yaw, Left Yaw commanded Pitch Up and Right Yaw commanded Pitch Down. Specifically related to the accident, when Vojvodich applied aft stick to rotate the aircraft, the pitch rate gyro commanded a large rudder input producing left yaw…

The accident board therefore concluded that the flight line electrician, his supervisor and the inspector were negligent. Furthermore, a design deficiency had made it physically possible to connect the wiring harnesses to the yaw and pitch rate gyros in reverse. As a consequence of the accident, maintenance procedures were tightened up and Lockheed completed a detailed review of the entire aircraft design, to ensure that all other components were made ‘Murphy Proof’.

OXCART DESCRIBED

Viewed in the context of the best frontline fighters of the day, the early Century Series jets, including the F-100 Super Sabre and F-101 Voodoo, Oxcart was a giant leap into the technically unknown, doubling and trebling their altitude and speed envelopes, respectively. It would cruise in afterburner at Mach 3.2, possess an unrefuelled range of 4,000nm and have an end-of-cruise-climb ceiling of between 84,500 and 97,600ft.

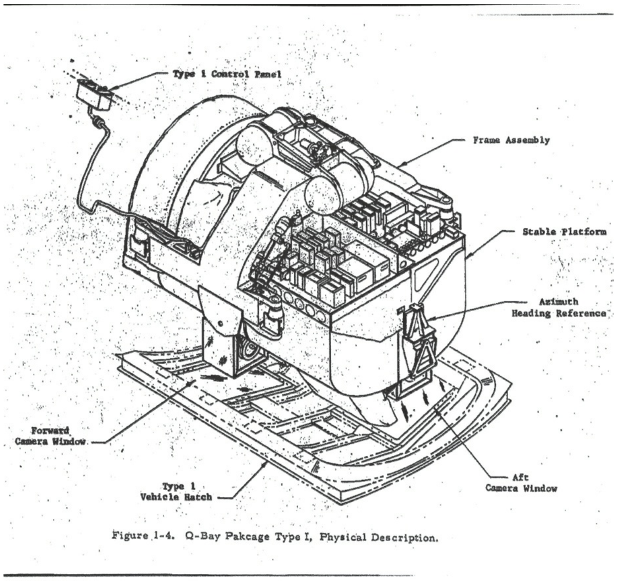
Above 80,000ft the ambient air temperature is -56°C and atmospheric pressure just 0.4psi. However, cruising at one mile every two seconds, the A-12’s airframe temperatures soared to between 245 and 565°C. Accordingly, 85 per cent of the aircraft’s structural weight was titanium to cope with the extreme temperature environment.

The Pratt & Whitney J58 engines each initially produced 29,500lb of thrust (increased to 32,500lb in the 'J' engines), and required 100,000cuft of air per second at design speed. Such an awesome performance envelope ensured that virtually everything on the aircraft had to be invented and built from scratch.

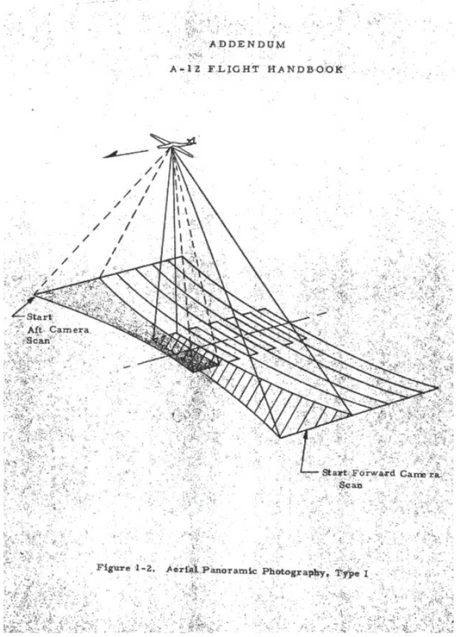
At Mach 3.2, the TIT exceeded 1,100°C, forcing development of a unique fuel, known originally as PF-1 and with a much higher ignition temperature than JP-4. Standard ignition systems were incapable of producing the required heat for PF-1's combustion and a chemical ignition system (CIS) was therefore developed using a highly volatile pyrophoric fluid known as tri-ethyl borane (TEB); it was extremely flash sensitive when oxidized.

A small TEB tank on the aircraft enabled engine and afterburner start on the ground and aloft. The tank was pressurized with gaseous nitrogen to ensure the system remained inert. Liquid nitrogen carried in two dewar flasks also provided a positive 'head' of gaseous nitrogen in the fuel tanks – this insured against vapour ignition as the wet (non-lined) fuel tanks depleted and prevented them from crushing as the aircraft descended into denser air to land or refuel.

The PF-1 fuel was extremely caustic, eroding traditional fuel bladders and lines. Therefore, the KC-135 tankers carrying Oxcart fuel required special fuel tanks and lines separate from those needed for their own JP-4. To accommodate the PF-1, the liners in the KC-135's forward body, centre wing, aft body, and upper deck fuel tanks, along with the air-refuelling manifold, were replaced with a special ceramic material impervious to PF-1; this expensive modification added considerable weight to the aircraft.


Type 1 Control Panel
Frame Assembly
Stable Platform
Azimuth Heading Reference
Forward Camera Window
Type 1 Vehicle Hatch
Aft Camera Window
Figure 1-4. Q-Bay Pakcage Type I, Physical Description.

The Type 1's forward and aft scanning heads provided stereo overlap at nadir, before each scanned out to the left and right, 67° either side of the Oxcart's track. (A-12 Flight Handbook CIA via Frank Murray)


ADDENDUM
A-12 FLIGHT HANDBOOK
Start Aft Camera Scan
Start Forward Camera Scan
Figure 1-2. Aerial Panoramic Photography, Type I

Built specifically for the Oxcart programme, the Perkin-Elmer Type 1 camera used two scanning heads carried on a single stabilized platform. (A-12 Flight Handbook CIA via Frank Murray)

In addition, compared to regular AR, rendezvous and refuelling procedures differed dramatically for the A-12 'receiver', the tankers requiring additional navigation and communication equipment to suit. During 1961–62 the CIA funded the modification of an initial cadre of KC-135s (determined by the minimum number needed to sustain maximum flight operations for ten Oxcarts). SAC identified 21 KC-135As for modification, all low-time airframes with good maintenance records.

Originally the A-12 refuelling mission was to be assigned to the 924th Air Refuelling Squadron (AREFS), 93rd BW at Castle AFB, which was located relatively close to Area 51. However, with the subsequent development of the SR-71, SAC successfully argued that the SR-71s and their dedicated KC-135s should be co-located at Beale AFB, so the refuelling mission went to the 903rd AREFS, 4126th Strategic Aerospace Wing (later re-designated the 456th SAW).

To eliminate the caustic effects of PF-1, the Shell Oil Company, Ashland Oil Company, and Monsanto Chemical Company developed a low-vapour pressure, less caustic replacement fuel known as JP-7. This eliminated the need for ceramic linings, which were later removed from the modified KC-135s and replaced by the standard rubber liners. The KC-135 tankers could burn JP-7, although not as a primary fuel, and following an ‘air flush’ of the JP-7, the tanker could then carry JP-4 in all its tanks as well as offload it to any receiver.

During their first four years of operations, the A-12 and SR-71 tankers retained their KC-135A designation. On 16 June 1966, however, Aeronautical Systems Division (ASD) specified an *en masse* re-designation of the 21 dedicated KC-135A aircraft to KC-135Q, although the change did not take place until the latter half of 1967; why the series suffix ‘Q’ was selected is unknown.

NAVIGATION EQUIPMENT

The Oxcart’s primary navigation system was the YG8027A1 INS with an MA-1 compass as backup. An inflight magnetic tape data recorder stored time, geographic position and attitude information from the INS, together with pertinent information from the camera package. An AN/ARC-50 UHF and an AN/ARA-50 UHF-DF were used for security communication and generated range/bearing data for air refuelling rendezvous. In friendly airspace a modified DF203 automatic direction finder (ADF) was used for ‘homing’, and an ARC Type 15F VHF omni-range (VOR) and AN/ARN-58 glide slope and marker were used as navigation and landing aids. An AN/APX-46 was provided for identification friend or foe (IFF) purposes.

The A-12's camera system was located in a pressurized area known as the Q-bay, located behind the cockpit. This same area accommodated the raised second cockpit in the AT-12 trainer. (Jim Goodall Collection)

MISSION SENSORS

VIEWSCOPE

The Baird-Atomic 6642-1 periscope system enabled the pilot to see the ground below. It had two settings. Wide-angle provided a conical field of view that could be enlarged to 131°. With this setting selected and normal side vision through the cockpit windows, the pilot could scan from horizon to horizon forward of nadir (a point on the earth's surface directly below the aircraft) and also had a narrow field of view providing coverage of 57° forward of nadir.

CAMERAS

Three different cameras were developed for the Oxcart programme. Eastman Kodak produced the Type II, a high-convergent stereo unit using a 21in. lens focused onto 8in. film. It produced pairs of images covering a swathe 30 miles either side of the Oxcart's track, with approximately 30 per cent stereo overlap. Film capacity was 8,400ft and the fine grain film provided a ground resolution of 17in. at nadir.

Hycon's A-12 camera was developed by Dr James Baker and known as the Type IV. It was a development of the Type B camera used so successfully in Aquatone. Its 48in. f/5.5 lens focused images onto 9.5in.-wide, fine grain film and, like its predecessor, could provide seven frames, covering a swathe 41 miles wide with a stereo overlap of 19 miles. Its capacity was 12,000ft and the package provided a ground resolution at nadir of just 8in.

Only the Perkin-Elmer Type 1 aerial panoramic camera system was used during Operation *Black Shield* missions, however. It gathered its images transverse to the A-12's line of flight.

The camera package consisted of two major assemblies, a stable platform and a supporting frame. The former contained the camera systems, associated subsystems and a stabilization system. The stabilized platform was gimbal supported at its centre of gravity via a rod fixed to the frame assembly. This was installed directly into the A-12's Q-bay on four isolation shock mounts.

The platform operated in either caged or uncaged conditions. In the caged condition the platform was locked to the frame and therefore fixed with respect to the A-12. In the uncaged condition, the platform was freely suspended from the gimbal support rod and allowed to stabilize with respect to roll rate and pitch.

Forward and aft optical systems within a single camera package on the stable platform accomplished the photography. The forward system scanned the target area from 67° to the left of nadir to 21° to the right of nadir. The aft optical system scanned the target area from 21° to the left of nadir to 67° to the right of nadir. The camera package thereby provided 42° of stereo coverage directly below the aircraft, and a total swathe 134° wide (which from 80,000ft was 72 miles). The scan cycle time was 4.8 seconds and each frame was timed to produce a 30 per cent overlap. Ground resolution was 1ft at nadir and 3ft, depending upon haze degradation, at the outer edges of the image – 36 miles left or right of the Oxcart's track.

The f/4.0 19in. lens gave a frame size of 27.6 × 6.3in. Transport of the 5,000ft of film for each camera was by a concentric supply and take-up system to ensure that film weight remained centralized, thereby minimizing potential changes in the aircraft's centre of gravity as the film advanced. Since inflight temperatures at the camera viewing port could vary between -40 and 290°C, an isothermal window provided a protective barrier between the severe temperature gradients and the camera's film. This was sealed to the Type 1 camera and a pump used to create a vacuum between the camera base and the glass.

The entire camera assembly was lowered through a removable hatch into the Q-bay and the camera sought its targets through a high-quality quartz window that measured 22 × 23in. Problems encountered when bonding the window to its metal frame were eventually overcome during a three-year, $2-million programme that developed a unique fusing process using high frequency sound waves.

SIDE LOOKING RADAR (SLR)

An SLR was designed for Oxcart and designated the AN/APQ-93 (XA-1). It was developed and procured under a USAF black world programme known as INVAR. The high-resolution synthetic-aperture radar used optical recording (film), with doppler signal and ground-based optical correlation techniques. Two flight units and one engineering unit were procured, together with a strip correlator and two detailed correlators for support.

The radar itself weighed in at about 950lb and was equipped with a 10ft-long antenna. It operated at a frequency of 9,432GHz and had a pulse width of 20 nanoseconds. Peak power was one megawatt and the pulse repetition frequency (PRF) was 4,000 pulses per second. Its image resolution was 8ft in azimuth over a swath of 20nm wide, centred about 30nm off track. The radar imagery was recorded onto 500ft of thin film, which recorded about 1,000 track miles.

The system was first proposed in April 1960 by the Scientific Engineering Institute. Development of the radar was initiated in August 1960 by Westinghouse, and the airborne recorder and optical correlators by Itek. Initial flight tests began in March 1962, utilizing an especially modified F-101 Voodoo. The system was delivered to Area 51 in 1964, where it underwent extensive ground checks. In early 1965, the system was returned to the factory, and tests continued using the F-101 as Oxcart test aircraft were unavailable.

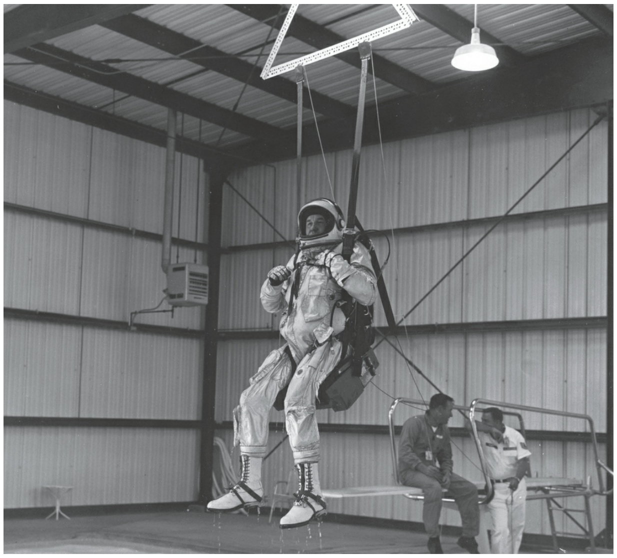
Over 200 flights were made in the F-101 and in late 1965 it was decided to reinstitute the radar flight test programme utilizing an A-12. Consequently, a year later the equipment was returned to Area 51 and flight test work began.

Initial flight tests were unsuccessful as the antenna suffered breakdowns when operating at altitude, a problem that was however resolved by December 1967. Unfortunately, as only one Oxcart was configured for the radar, it became an early victim of the short-sighted decision to phase down the Oxcart programme, on the basis that operational capability would not have been available without extended downtime whilst additional aircraft were being modified.

BIRDWATCHER

Birdwatcher was a monitoring system unique to the A-12. It employed a multiplexed High Frequency/Single Side Band (HF/SSB) radio system and was designed to telemeter signals concerning the operation/non-operation of various aircraft systems down to a specially equipped ground station. The frequencies selected for any particular mission were briefed and noted by the pilot on hand-cards; they were also annotated on the mission filmstrip, which was displayed to the pilot in the cockpit.

The system comprised two main elements, air and ground. The air element employed an antenna consisting of a tubular structure within the pitot/static system located at the front of the aircraft. A relatively short antenna, it was closely matched to the airframe's ground plane, effectively creating a much larger and fairly efficient antenna from the aircraft itself. Of Birdwatcher's 40 channels, 32 monitored individual aircraft systems; channel 54, for example, covered the starboard engine's exhaust gas temperature (EGT), channel 7 the starboard engine's fuel flow and channel 3 the aircraft's altitude.



Ken Collins uses Area 51's heated indoor pool during water survival equipment training for a simulated 'feet-wet' parachute landing. (CIA)

If any pre-set parameters of the monitored systems were breached, Birdwatcher keyed and modulated the HF transmitter with a coded signal. This consisted of three consecutive half-second bursts, each separated by a five-second period of silence. During each of the half-second bursts, the aircraft's identity and the condition of each of the systems monitored was transmitted. These three bursts could be heard through the pilot's headphones as three chirps, leading to the name Birdwatcher.

The pilot had only limited control over the system. In the cockpit there were two switches labelled 'A' and 'B'. The 'A' code was usually used to signify to the ground station that the aircraft had reached a pre-designated point in the mission and was in a 'GO' condition, such as at the end of a successful air refuelling, or upon reaching a predetermined distance to go (DTG) or turn point. The pilot generally activated the 'B' code to indicate that the aircraft had experienced an abort condition. The two buttons could also be used sequentially to indicate that something unusual had occurred. For example, 'B' followed by 'A' might be interpreted to mean that the Article had an abort condition, but was not in an emergency situation.

Involuntary Birdwatcher codes were transmitted automatically when any one of a number of sensors tripped the encoder. It also transmitted a code when the Oxcart's electronic countermeasures (ECM) equipment was tested with the built-in-test (BIT) switch. A 'mute' switch inhibited all the A-12's radio emitters except Birdwatcher. It prevented accidental transmissions by TACAN, UHF radio, etc and the pilot was usually instructed to operate the switch by the mission filmstrip prior to entering denied territory.

Birdwatcher could also be interrogated by appropriately equipped ground stations. The command post (CP) could, if required, cause Birdwatcher to transmit a short burst of information that would only include the coded identification of the Oxcart, if no other sensors had already tripped. To the dismay of a couple of pilots, some of those monitoring the aircraft's progress from the ground station at Kadena occasionally interrogated the aircraft when it was over enemy territory.

The ground station for Birdwatcher at Area 51 was located just outside the entrance to the CP in the secure communications room, an area that no one was allowed access to without good reason. From here an operator monitored an oscillograph paper recorder that reacted to the Birdwatcher's 'chirping'. Lights were used to develop the oscillograph paper to a point where it was possible that the technician could place the paper on a readout cursor and see which sensor had tripped. He then activated a switch that illuminated an appropriate light on a light board located in the CP, alerting other officers as to the aircraft's status.

ELINT

During the course of its 29 operational missions, the A-12 deployed two ELINT gathering systems. The first, known as Signal Interception Package (SIP), was carried on Oxcart's first three operational missions. It was a small unattended collection system, covering the frequency spectrum of from 50MHz to 11,00MHz.

SIP was replaced by System 6S, from mission four. Built by Ramo–Wooldridge, it was an advanced wideband collection system comprising of a miniaturizing wide-frequency receiver that monitored a frequency range of 50MHz to 12,500MHz. The signals were split C and recorded by two three-channel recorders working at 2¼in. per second. C and X-band information, together with capture time and left or right of track directional information, was channelled to one recorder, while the same data for L and P-bands was stored by the other unit. The system failed only once due to a drive belt failure.

ECM

Very little changed on Oxcart's ECM suite from the initial installation. All systems were activated by a single, three-position power switch labelled 'OFF', 'Standby' and 'ON'. There was also a BIT switch that activated a logic test to ensure each element worked correctly. These checks were undertaken by the pilot prior to entering denied territory; satisfactory completion of the checks caused the Birdwatcher to chirp, confirming to the ground station that the aircraft was about to penetrate hostile airspace. If the BIT check failed, it was mandatory for the pilot to abort the mission.

The only element of the system visible to the pilot was a series of five lights positioned above the view scope and enclosed in the cockpit glare shield. The outboard lights were marked 'DF'; the set inboard of these was marked 'LI' and the larger centre light was known as the 'JAM GREEN' or 'JAM RED' light. The DF lights illuminated when the ECM system detected a SAM target acquisition system tracking the Oxcart. If only one of these two lights was on it indicated the general direction of the tracking radar; if both were on, it meant the system was ahead or there were systems on both sides of the flight path. The LI lights illuminated when the SAM site's radar had gone into a high pulse repetition frequency (PRF) mode, usually indicating that the site had launched one or more missiles. Frank Murray recalls the usual sequence of events:

> When a SAM site was on you, the DF light or lights would come on and this started the Birdwatcher chirping. Then the LI light(s) would come on, indicating a missile launch. Then came the moment of truth! Sometime into the missile flight time the active parts of the ECM suite would activate and the JAM GREEN light would illuminate. This indicated to the pilot that the ECM system was working to counter the missile's guidance system. If, however, the JAM RED light illuminated, this indicated that the active elements of the system weren't working correctly, in which case the pilot had to depress and hold down a button marked 'JAM O'RIDE', located on the top-right portion of the flight control stick. This activated the noise-jammer part of the ECM suite. I have to say though, that I'm not aware of anyone in the programme having to use the 'JO' switch.

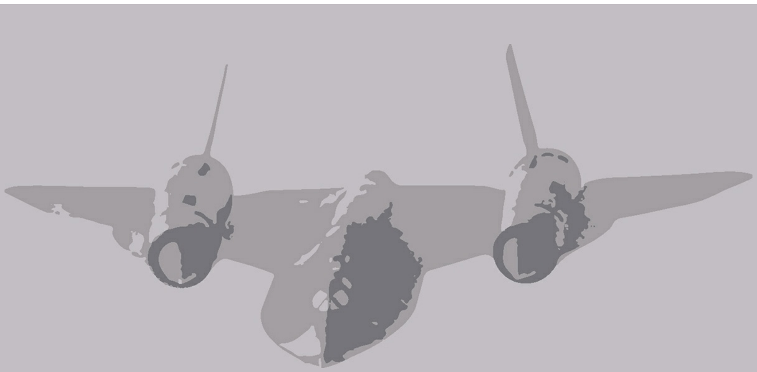
The various elements of the ECM suite were given cryptic names:

PIN PEG was a passive radar homing and warning receiver (RHAW) that monitored S and C-band frequencies to indicate the presence and approximate position of 'Fan Song' target acquisition radars associated with the SA-2; if required, it could activate the jammers.

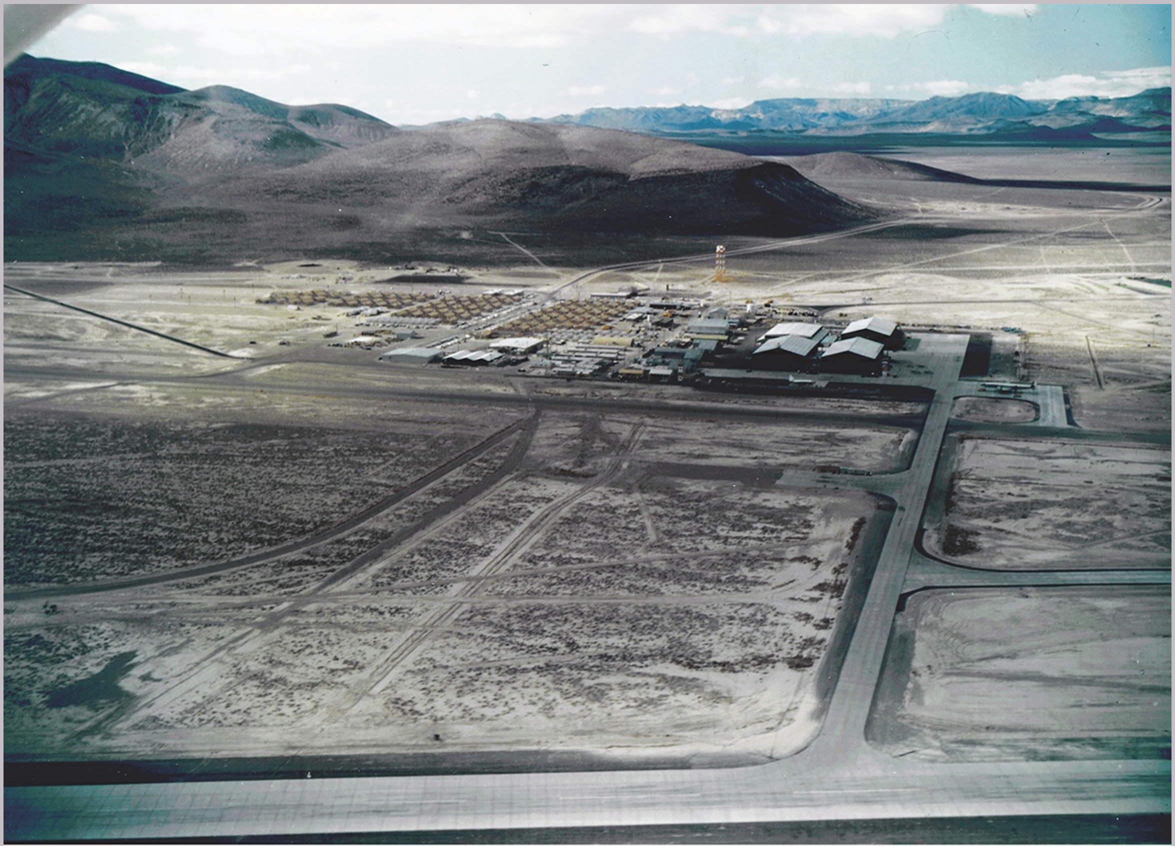
BIG BLAST transmitted approximately 90 seconds of noise jamming in the S and C-band of frequencies that denied the SA-2 target range, forcing it into a three-point guidance mode and early arming of the fuse.

BLUE DOG weighed in at 480lb, required a power input of 20kW and had an antenna gain greater than 79dBm. Using a technique known as range gate pull off, it deceived the SA-2's missile guidance system by actively generating false guidance commands.

PIN PEG and BLUE DOG were used in association with 'Big Blast' or 'Mad Moth'. The former covered S and C-bands, generating barrage and deceptive noise protection against SA-2s, while the latter provided protection in S and C-bands against SA-2s through angle deception.



CHAPTER 4: AREA 51



This image of Area 51 was taken some years after the Oxcart programme had been terminated. Note the parallel runways that extend onto the dry lakebed. (CIA Roadrunners via T. D. Barnes)

DEVELOPMENT

It was almost inevitable that Oxcart flight testing would be conducted from Groom Lake, the area in which Watertown had been established. When the U-2 programme moved out of Watertown, the base remained more or less unoccupied, but all that was about to change. Before the A-12 arrived, however, an enormous amount of work was required to bring the base up to standard, since virtually all its facilities were inadequate to support such a significant, high-tech flight test programme.

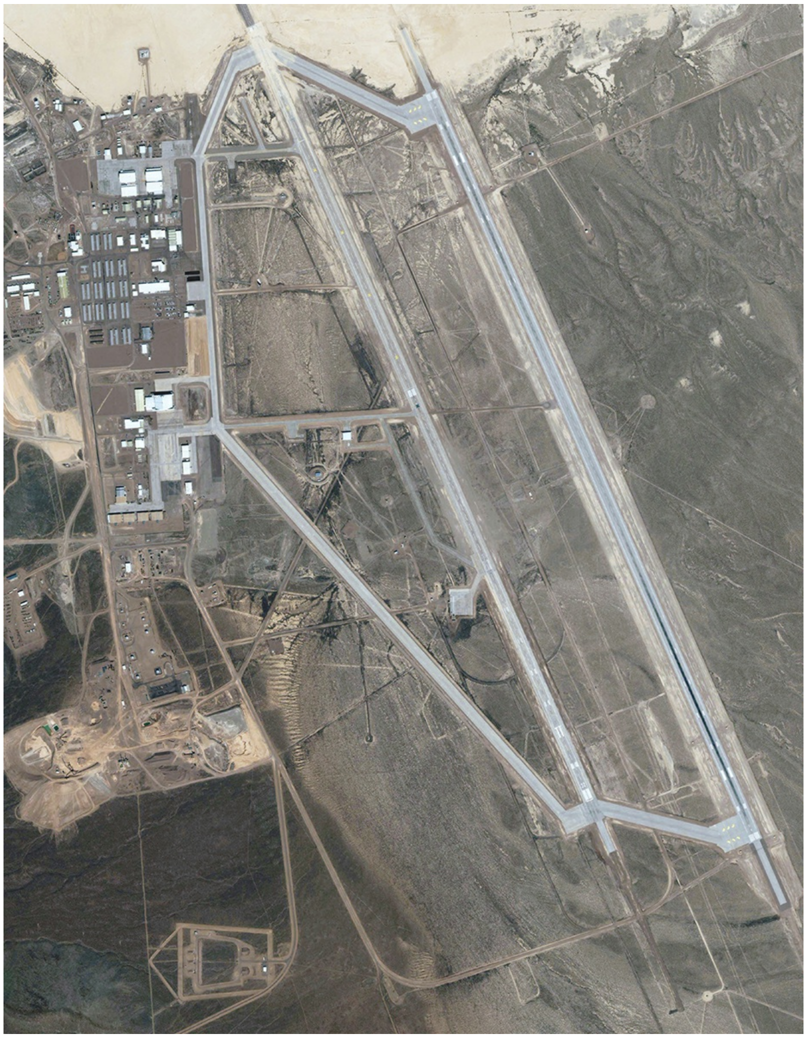
A small army of contractors carried out the work. Nevada state law required all contractor personnel remaining in-state for more than 48 hours to report to state authorities. Such an undertaking by so many individuals would inevitably attract unwanted attention and breach the project's security. The CIA's general council therefore came up with the solution – it discovered that government employees were exempt from the requirement, so all site contractor personnel received appointments as government consultants.

One of the first tasks undertaken was to drill a new water well and recreational facilities were provided for the workers, who were billeted in trailer houses. In September 1960, work began in earnest and continued in double-shift schedules until mid-1964. In addition to a new runway, 18 miles of off-base highway was resurfaced to allow 500,000 US gals of PF-1 fuel to be trucked in every month.

THE RUNWAY

The runway was made of reinforced concrete, 12,000ft of which was laid on the lakebed and approximately 8,000ft more covered native soil; each end was provided with a 1,000ft graded overrun. The 8,000ft section extended out to the southeast and included a taxiway at the lake edge.

A returning A-12 could usually land and halt within this section and use the taxiway to exit the runway. Difficulties arose, however, if the aircraft overshot the taxiway entrance, since the runway wasn't wide enough to turn an A-12 without it having to venture onto the lakebed, so a turnaround pad was added to the lakebed section in 1965. A fire truck pad was positioned near the intersection of the runway and lakebed, and when A-12s were flying, a truck stood alert on the pad. Take-offs and landings were made to the northwest, enabling use of the extended runway and, if necessary, lakebed.



Oblique shot of Area 51 facilities looking south. (CIA)

In fact, the lakebed proved extremely useful, especially during a high-speed abort at or beyond refusal speed and particularly if the emergency was complicated by a drag-chute failure. To aid the stopping process in this condition, an Archimedes curve was painted onto the lakebed and tightened as it extended off to the east of the runway; this increased deceleration drag without putting undue strain on the undercarriage and its attachment structure. To aid pilot acquisition, a few dead trees were positioned along the length of the curve.

The lakebed could also be used if the main runway crosswind was excessive. However, there were times when it was off-limits due to standing water, since its surface lacked load-bearing strength when wet.

NAVIGATION AIDS

INSTRUMENT LANDING SYSTEM

Prior to the operational deployment to Kadena AB, Okinawa, some A-12s were retrofitted with an instrument landing system (ILS) receiver. In order to test it, a temporary ILS was constructed at the eastern end of the lakebed, with test approaches made to the west.

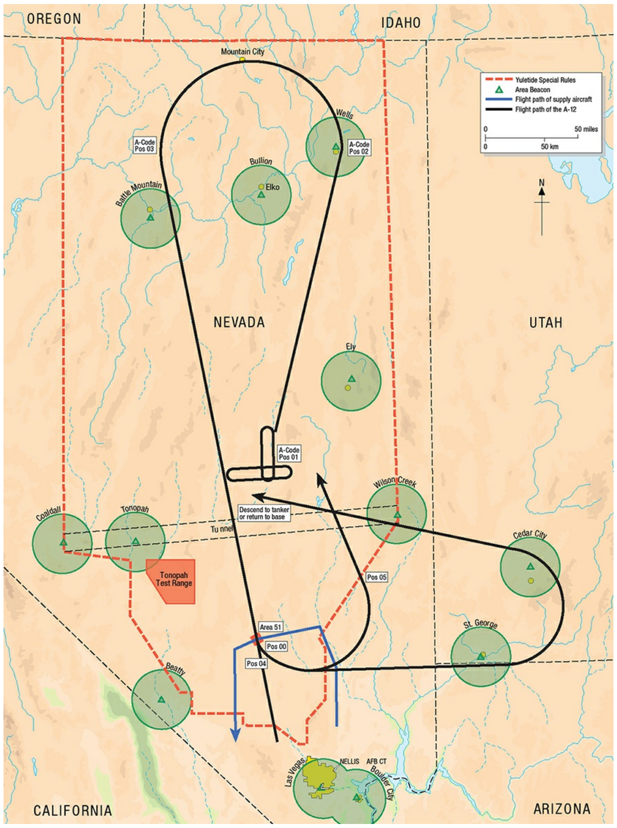
TACAN

Area 51 is situated about 3 miles south-southwest of Bald Mountain, which rises to a height of 9,300ft above mean sea level (amsl). Another area of high ground, Papoose Ridge is located less than a mile to the west-southwest of the runway. Ideally a TACAN beacon would have been placed on the airfield, as close as possible to the runway it was to serve, but with high ground surrounding Area 51, this was not possible. Instead, the TACAN was situated on top of Bald Mountain, or ‘Baldy’ as it was referred to by the pilots. Such elevation gave the equipment an outstanding range capability, but the mountainous terrain complicated instrument approaches into the Area. Consequently, instrument approaches were made to align the aircraft inbound to runway 32. The TACAN approach was a basic teardrop let-down, with a left-hand procedure turn back to the beacon on a radial that would allow the pilot to locate the runway at a specified TACAN distance and altitude. On most occasions it was used to position the aircraft to a point where the ground-controlled approach (GCA) precision radar could acquire it.

GCA

The base’s AN/FPN-16 GCA radar trailers were located almost directly in front of the control tower, to the west of the main runway, in between it and the main taxiway. The facility comprised two trailers, an Operations trailer and a Maintenance trailer, mounted so that they could be rotated to align the precision-approach radars using metal radar reflectors located at the approach end of the runway. The radar was powered by the base's main power grid, backed up by a generator in the Maintenance trailer; also in this trailer were air conditioning units and the surveillance radar. The Operations trailer housed the precision approach radar (PAR); PAR scopes were located in the trailer and a building situated near the tower.

Twenty-five men were assigned air traffic control (ATC) duties, including those working in the tower and approach control, and at the nearby Nevada Test Site (NTS). Eight of the enlisted controllers were dual-rated for GCA duties.


OREGON
IDAHO
Mountain City
Yuletide Special Rules
Area Beacon
Flight path of supply aircraft
Flight path of the A-12
0
50 miles
0
50 km
N
Wells
A-Code Pos 03
A-Code Pos 02
Bullion
Elko
Battle Mountain
NEVADA
UTAH
Ely
A-Code Pos 01
Wilson Creek
Coaldall
Tonopah
Descend to tanker or return to base
Tunnel
Cedar City
Tonopah Test Range
Pos 05
Area 51
Pos 00
Pos 04
St. George
Beatty
Las Vegas
NELLIS
AFB CT
Boulder City
CALIFORNIA
ARIZONA

The Yuletide Special Rules Area (SRA) was maintained for Mach 3 A-12 operations out of Area 51. It contained two tankers tracks, of roughly north/south, east/west orientation, with standard waypoints and turning points established at 'Pos' positions. It extended from 24,000ft up to 60,000ft and was bisected at its southern end by the 'tunnel', a civilian airway extending from 24,000 to 40,000ft, which A-12s generally had to fly under or over. (Osprey)

FACILITIES

In 1963, most of the housing at Area 51 consisted of old, wood frame, Babbitt duplex family accommodation acquired from the ammunition depot at Hawthorne, Nevada. More than 80 of these units were dismantled and transported through the boondocks of Nevada. At the new site they were re-erected in a quadrangle in the middle of the base and reconfigured to sleep four to six people.

Each house featured two bathrooms and two living rooms. They were also equipped with evaporation cooling systems and propane-fired boilers – most incumbents agree they were quite comfortable. One of the buildings was fitted out as the Oxcart pilots' dining room: here special low-residue meals were prepared when extended missions were to be flown. Another building, referred to as 'House 6', served as an informal gathering place and do-it-yourself bar.

In the early years of the programme the mess hall consisted of a couple of old adjoined buildings situated next to the Operations facility. After evening meals had been served it doubled as a film theatre, managed by Jim Casteel. Later a new mess hall was constructed from where food was served 24 hours a day. Throughout the programme everyone agrees that the food, served up by Reynolds Electric Company (Reeco), was outstanding.

For recreation there was a gym, squash and tennis courts, and a small pitch-and-putt golf course. Several of the pilots and support staff also got into building and flying radio-controlled model aircraft from the dry lakebed during the evenings. Later the base built a swimming pool. This doubled up as a training facility for Oxcart pilots learning water survival techniques while wearing the full pressure suit.

During their training, Oxcart pilots also used a parasail to get up to altitude before being lowered into Lake Mead, again for water survival training. A Coast Guard power launch was the tug that launched them into the air. One pilot recalls that it wasn't the safest thing he'd ever been told to do – trying to run to lift-off in a complete pressure suit and survival kit without falling on the lake beach was, he said, decidedly 'dicey!'

The Base Headquarters building housed the 1129th Special Activities Squadron's commander, his administrative staff and the CIA station chief and his staff, as well as the Base Security Section and the medical facility, from where the flight surgeons worked.

As with all operational bases, the Mission Ops Building was the hub for flying operations and included regular base ops functions, a main mission briefing room, a flight planning section and a personal equipment section, where flight suits and pressure suits were kept and maintained. It also housed the Stan/Eval section. The Stan/Eval pilots were responsible for training and maintaining flying standards.

There were also offices for the project pilots. The CP was located within the building's inner sanctum. On one of its large walls was a map of the United States upon which were detailed all the usual A-12 flight routes; its backing was sheet steel and small magnetic A-12 silhouettes, on which individual serial numbers were engraved, were positioned along the routes being flown, enabling CP personnel to keep a check on proceedings. Adjacent to the CP was the Secure Communications Room; radios were used to monitor most missions within the US, as were HF/SSB and Birdwatcher.

Accommodation and hangerage at Area 51 at the time of Oxcart. (CIA via TD Barnes)

Finally, at the rear of the building the meteorological section and a small Link trainer room were located. A separate building near the main taxiway served the security needs for classified document control. Fenced and patrolled by security guards, it was opened for access by the 'crew bus', which carried project pilots to the Agency hangars and contractor test pilots to the Lockheed hangars and their dedicated test aircraft.

HANGARS

The A-12 hangars and the main parking ramp were located on the southern perimeter of the base, connected to the main runway by a taxiway. Three large ex-US Navy hangars were moved to the test site and housed the A-12s while they were being reassembled. They also provided hangarage for two Lockheed F-104 chase aircraft, and test Articles 121 and 122. Article 129 spent some time in this accommodation during flight trials, before its return to the Agency as mission aircraft.

Several old hangars from the U-2 days remained on-site and these served as engine and machine shops; other smaller buildings housed the avionics facility and another the INS repair station. A huge metal-clad warehouse was home to the Logistics Supply Center, while a large petrol, oil, lubricant (POL) dump, located away from most other structures, stored the fuels required by aircraft and base vehicles.

Custom-built hangars housed the project aircraft. They had doors at either end to facilitate drive-in, drive-out operations and in-hangar engine starting. A large central bay, flanked on each side by more hangars, provided offices for maintenance staff and several specialization shops. Opposite these hangars was located the 'peek building', designed to cover the nose section of the A-12 while the highly classified camera systems were being installed. The Oxcart was pushed nose-first into the facility and sliding doors to either side were closed to encapsulate its forward section; in addition to providing additional security, it kept wind-blown sand and other debris away from sensitive optics.

Another single-bay hangar was used for the maintenance of support aircraft and housed several F-101 chaseplanes.

RATSCAT RANGE

A radar target scatter range was built north of the main Lockheed hangars. It comprised threat simulators, precision radars and optical systems; the latter could be used to track A-12s from the ground as they flew local test sorties. The RatScat equipment assessed the RCS of sub-scale and full-scale aircraft during the early development days of the A-12. The test subject was mounted atop a hydraulic lift, located some distance from the radar head, on the dry lakebed and then positioned at various aspects. The lift was masked with Echosorb before readings were taken of the aircraft's RCS. A-12 Article 122 spent several months on 'the Pole'.

U.S. AIR FORCE
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Two of the Area 51 support aircraft during the Oxcart programme, a U-3B 'Blue Canoe' (left) and Cessna 210D. (CIA)

SUPPORT AIRCRAFT

During the spring of 1962, eight F-101B/F Voodoos arrived, mainly for use as chase aircraft flown by the project pilots. Two F-104s were also assigned for high-speed chase and mainly flown by Lockheed test pilots before being re-assigned to Edwards AFB when the three YF-12 were re-located. In addition, two T-33As were provided for mission support and proficiency flying for the many military staff pilots.

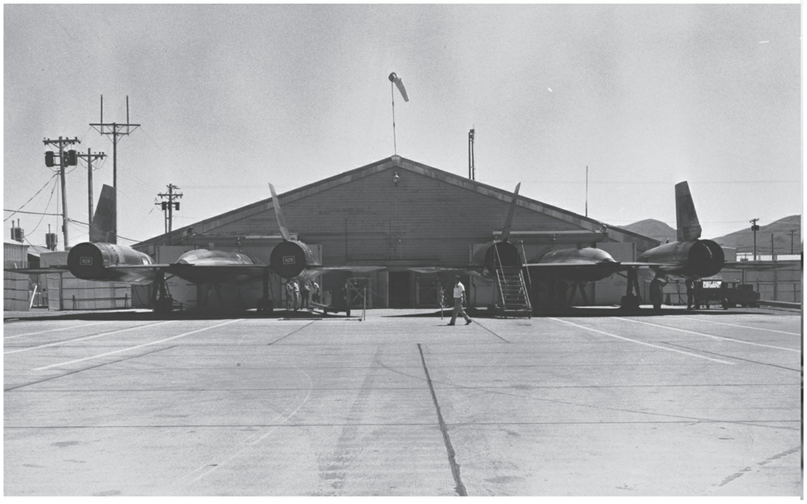
Light air transport was provided by a U-3B 'Blue Canoe' flown by some of the staff, while a civilian-registered Cessna 180, later replaced by a Cessna 210, was used on medevac and utility duties. Base rescue, fire suppression and local security was covered by an HH-43 before a UH-1 Huey replaced it. Logistics support, particularly for ferrying the J58 engines in and out of the base, was conducted by a C-130.

The weekly commute of staff into Area 51 from Las Vegas, as well as the airlift of special devices used for local technical studies, was initially achieved using a C-47 (later replaced by a Fairchild F-27, both aircraft operated under contract by Carco Inc). The majority of contractors, Lockheed workers and project pilots alike, made the Monday/Friday trip into and out of Area 51 in Constellations operating into Burbank. Another visitor to the desert base was Lockheed's prototype twin-engined JetStar, used by the likes of Kelly Johnson and his senior team.

That the physical location of Area 51 was an ideal secure site from which to conduct the Oxcart test programme is beyond dispute, but there were additional special needs that needed to be met to ensure the aircraft and its associated chaseplanes could operate safely. In response, an agreement was reached between the FAA, the Air Force and the Agency, setting aside a vast area of airspace. It joined the northern borders of restricted areas 4806, 4807, 4808 and 4809, and ran north in a box bordered by the navaids at Wilson Creek and Coaldale. The area extended to 42° north and was bordered to the east by 115° west and to the west by 118° west. Designated the Yuletide Special Rules Area, it rose vertically from 24,000 to 60,000ft amsl.

Flight above 60,000ft wasn't subject to FAA positive control, but for additional safety, when A-12s began operating routinely above this, their pilots used a simple code to hide their actual height from eavesdroppers by reporting that they were at an altitude of base plus a number. For additional security, the base altitude would change daily, so if, for example, it was briefed as 50,000ft and the Oxcart was cruising at 85,000ft, the pilot would report to the centre that he was at base plus 35. In this way ATC could keep a watchful eye out for other high-flying traffic and later, when SR-71s and U-2s were flying in those upper reaches, controllers would sometimes report 'company traffic' at an azimuth relative to the Oxcart's flight path.

Oxcart Articles 125 (60-6928) in the foreground and 127 (60-6930) in the nose-docking hangar. (CIA)



To keep wind-blown dust and uncleared prying eyes from the classified camera systems, conformal doors were fitted to one of the earlier U-2 hangars, enabling the A-12's nose section to be 'docked' inside. (CIA)

To accommodate a civilian airway that ran between the Wilson Creek Vortac and that at Coaldale, a 'tunnel' 10nm wide between 24,000ft and 40,000ft altitude was established. Area 51 traffic had to fly below or above it, or obtain prior clearance from Salt Lake ATC Center to fly through it. When the A-12 began test operations out of Area 51, most pilots elected to fly beneath the corridor northbound after take-off en route to the tanker and fly over the top southbound, especially if the A-12 was on the descent into the SOA. When the

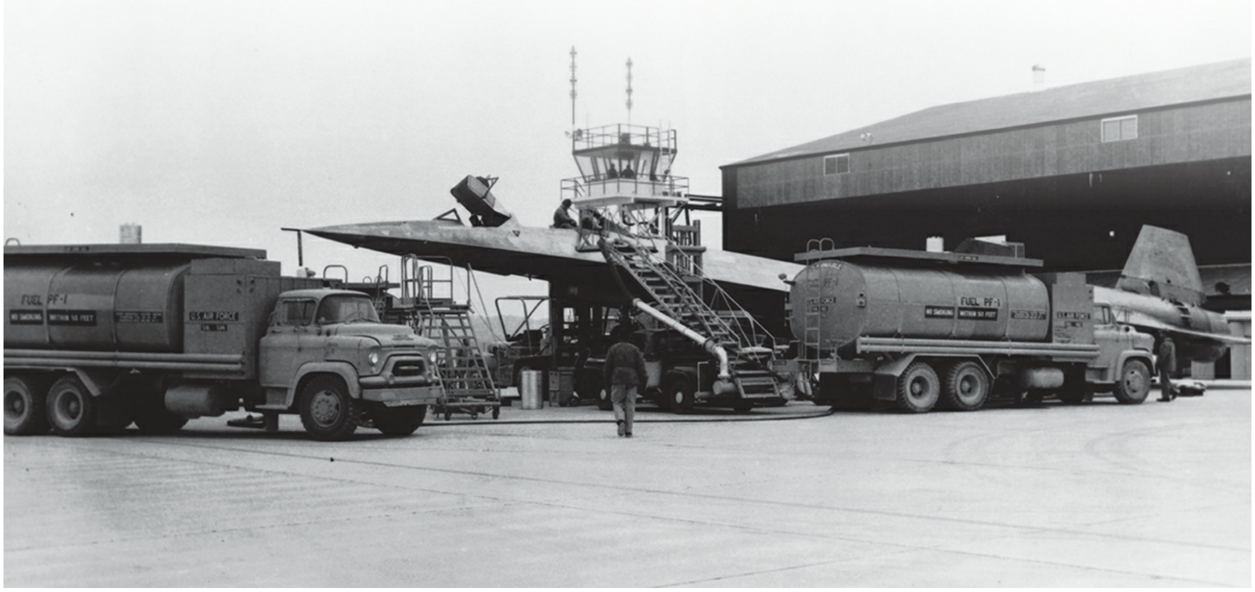
SOA was not required to support A-12 operations, the airspace reverted back to Salt Lake Center for use by airline and general aviation traffic.

Major Charlie Trapp flies Area 51's HH-43B during a fire exercise in crew extraction from a crash site. The helicopter's rotor downwash cools the area, spreads the foam and clears away smoke. (CIA)

Since there were no weather-reporting stations within the SOA, a weather scout was used. During the summer it launched from Area 51 at about 6:00am, or at first light during other seasons. The weather scout, in an F-101, usually flew 200 miles to the north, paying particular attention to cloud conditions in the refuelling areas and reporting conditions to Area 51's weather station on UHF radio. Having completed these duties, the scout was free to return to home plate via any route desired, usually before any other aircraft had taken off. One or two of the more mischievous pilots used the opportunity to check out the security guard post on the dirt road leading to the east of Bald Mountain – it seems that many a guard was startled back into reality by an extremely fast and very low returning weather scout! Upon landing the F-101 pilot reported to the weather station and command post, and related his report in more detail if required.

During a chase sortie on 26 September 1967, F-101B 56-0286 was returning home in company with the 'Titanium Goose'. It was already quite dark and while the AT-12 was nearing the approach to runway 32 at about 8,500ft, it appears that the chase pilot, James S. Simon Jr, lost visual contact with his charge. The Oxcart pilot told Simon that he was okay and had no further need for the chase aircraft; the A-12 then turned onto final.

When asked where he was, chase replied, 'In trail and moving over to the right side.' Shortly thereafter a fireball was seen to streak across the desert. The AT-12 pilot initiated a go-around at 500ft and 190kt. The wreckage of '0286 was found 4,000ft short of runway 32 and 2,000ft to the right of its extended centreline. It was determined that James Simon had made no attempt to eject and the CIA accident report concluded that he had inadvertently flown into the ground.



Article 924 during ground fuel tests at Area 51. When cruising at high Mach, the A-12 had a positive deck angle of 6° nose high. This test replicated the configuration by using two forklift trucks to raise the nose undercarriage to the appropriate height. (CIA Roadrunners via T. D. Barnes)

Jack Layton is made ready for a parasailing training sortie, which culminated in a 'feet-wet' landing in Lake Mead. Frank Murray said jokingly of the event, 'I'm sure they were trying to drown us all so they wouldn't have to pay us our enormous pay cheque!' (CIA Roadrunners via T. D. Barnes).

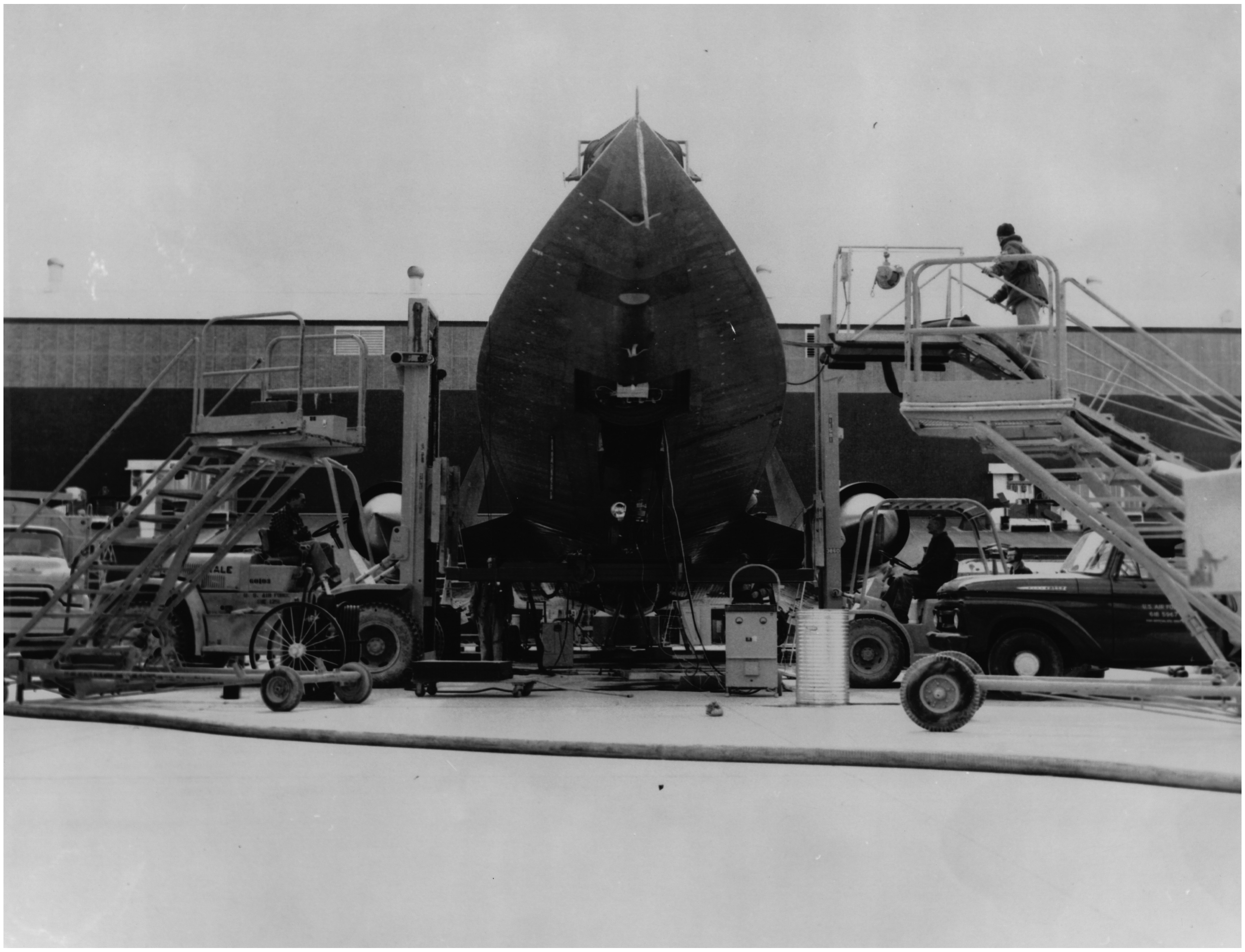
Another duty performed by staff and project pilots before the start of a day's flying was a security check of the Area's 'perimeter'. It was flown in the Cessna 210 as well as the HH-43/UH-1.

UNINVITED VISITORS

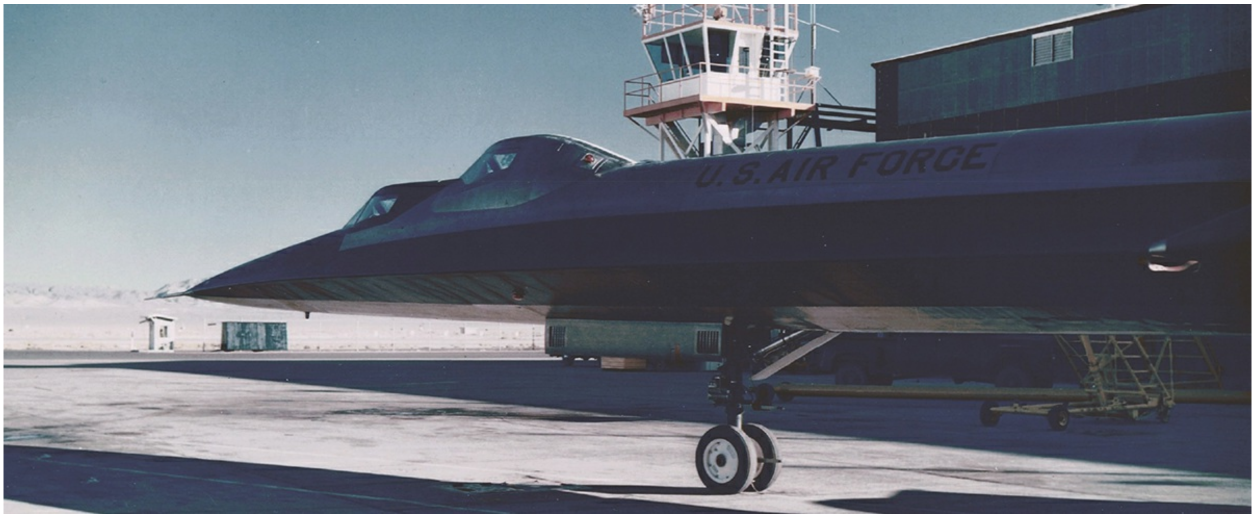
Mindful of the wilder imaginings of some elements of the media, several members of the Oxcart programme have confirmed that there were definitely *no* aliens at Area 51, at least not during their stay at the isolated base. However, uninvited visitors did drop in from time to time. Denny Sullivan recalls that one night a young lady and her rather drunk pilot boyfriend arrived. 'It seems that he convinced her that it was a good idea to fly from Reno down to Las Vegas in this lightplane to continue the party. He evidently lost his way and was getting low on fuel when he saw this nice big runway and landed. He was met by the security folks and, as I understand it, during the session with security, the gal got into seriously berating the guy for his stupidity and whacked him one with her purse!'

On another occasion Frank Murray missed the last Friday night Connie flight back to Burbank due to the late completion of an FCF. He was in his base house on the Saturday morning when he heard the sound of a light aircraft flying over the base, so he ventured out to see what was going on, as he now recollects.

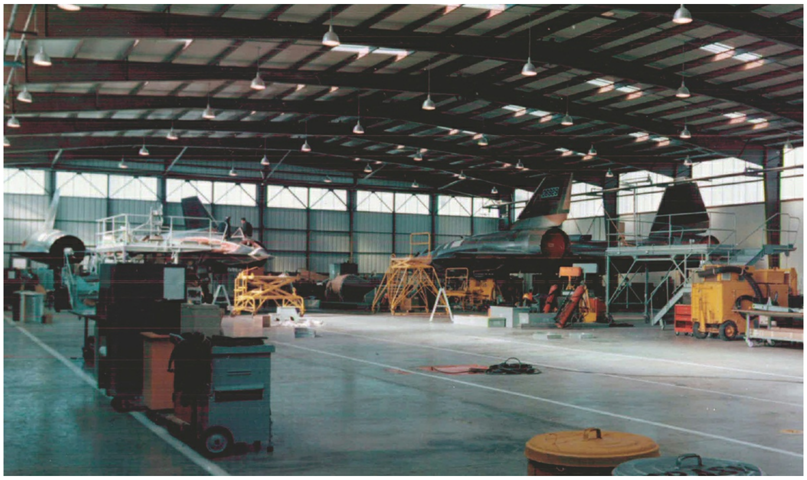
> At about this time one of the security guys drove up and told me that someone was landing on the taxiway. I jumped in the truck and went to see. As we caught up with our 'guest' he was shutting down on the apron in front of the big hangars. The guy then stepped out and said 'God, am I glad to be down, I've been flying around his huge desert, lost'.
>
> It turned out he was a student pilot, ex-USAF navigator, flying one of his solo cross-countries out of Apple Valley, California. Security checked out his story and decided to let him go with the usual signing away of his life about the Area. We filled up his little airplane with Mogas [Avgas] and told him to taxi out to the main runway and head off southeast and don't turn. He flew off to the cut in the ridges southeast of the Area and I never saw him again. I then went back to the house to continue work on building my radio-controlled model aircraft.



During the fuel test the aircraft’s fuel transfer sequence was activated and PF-1 pumped into the bowsers seen positioned around the aircraft, simulating consumption by the engines. Adjustments could then be made to the feed sequence prior to flight. (CIA Roadrunners via T. D. Barnes)



The two-seat AT-12 pilot trainer accumulated more than 1,076 hours in 614 flights out of Area 51 before the Oxcart programme was terminated. (Lockheed Martin)

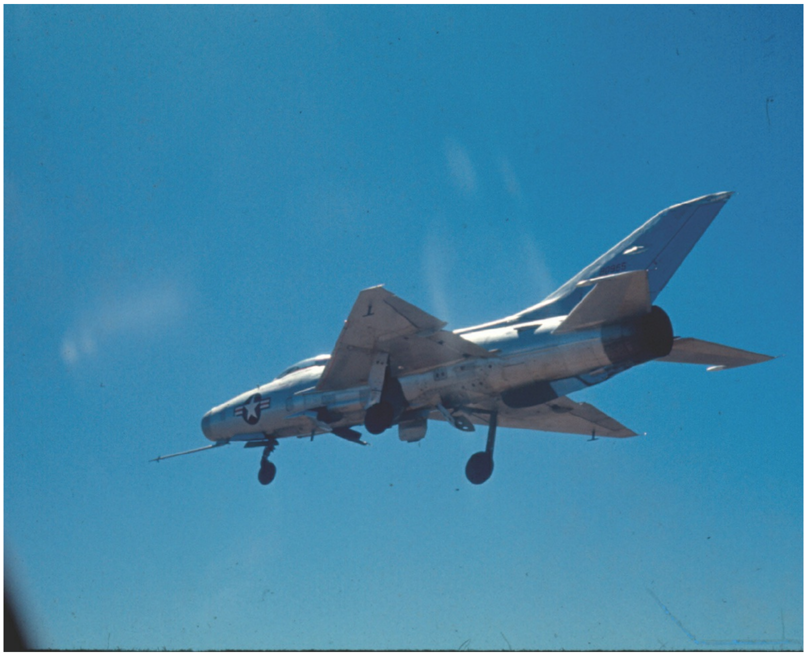


Two A-12s under routine maintenance in one of Area 51's hangars. The aircraft on the right is 60-6929 (Article 126), which was lost on take-off on 28 December 1965. (CIA)

Although similar incursions occasionally punctuated life at the test area, it is believed there was only one case of a 'guest' actually seeing an Oxcart; it occurred late in the morning on 29 June 1965. RAF exchange officer Flt Lt Jock Heron got airborne from Nellis AFB in F-105D 59-1772 of the 4526th Combat Crew Training Squadron (CCTS), 4520th Combat Crew Training Wing (CCTW), on a simulated nuclear weapons delivery sortie to one of the Nellis ranges. Jock recalls that sortie in an extract reproduced by courtesy of the

Rolls-Royce Heritage Trust (Bristol):

Having released a practice bomb I pulled off the target and suddenly the cockpit filled with smoke. Despite following the usual emergency procedures the problem remained, so with thoughts that an internal fire had developed, I declared an emergency and had little alternative but to seek authority to land immediately at The Ranch, which lay on the edge of a dry lakebed some 15 miles to the south east, inside the prohibited area of the test site. Permission was duly gained and my credentials were passed to the control tower using the emergency frequency.



Towards the end of project Oxcart, some facilities at Area 51 were used by the 6513th Test Squadron, the ‘Red Hats’. Under the classified Have Doughnut programme, Air Force Systems Command (AFSC) conducted exploitation and evaluation of an Iraqi Air Force MiG-21F-13 ‘Fishbed-E’ acquired by the Israeli Air Force after its pilot defected. To ensure programme security wasn’t compromised, the aircraft was referred to as a YF-110B for ‘administration purposes’. (USAF via T. D. Barnes)

The airfield looked deserted as I passed through the overhead before setting up for my approach and landing. The ‘Thud’ was well over maximum landing weight and I flew a wide circuit before making my final approach at a higher than normal speed to allow for the extra 8,000lb of fuel. Touchdown was straightforward and gentle, the braking parachute deployed normally and the aircraft slowed gradually to normal taxiing speed before turning off the long runway. I then shut down the engine and electrical power because of the continuing risk of an internal fire from the source of the smoke, which did not disperse until the canopy was opened.

Two vehicles met me, one of which was an engineering truck and crew, the other contained two men in civilian clothes. Having dismounted from the aircraft and ascertained that there were no external signs of fire I left the aircraft in the hands of the ground crew and was invited to board the second vehicle, which took me to one of the hangars adjacent to the aircraft parking area. Conversation was limited to the events surrounding the aircraft’s emergency and I was escorted to a room without windows where I was given a welcome cold drink.

This frame-grab is from footage shot inside an Area 51 hangar between February and May 1969. In the background can be seen an ex-Syrian Air Force MiG-17 'Fresco-C'. It was associated with an AFSC programme code named Have Drill and the aircraft was referred to as a YF-113A. (Paul Crickmore Collection)

The ensuing debriefing was courteous but prolonged and I was reminded of the classified nature of the airfield. After about an hour, one of the ground crew appeared and confirmed the cause of the smoke in the cockpit. Apparently the cold air turbine for the cabin air refrigeration system had seized and the overheated lubricant had ignited within the system. Although there was no real danger to the aircraft, the effects in the cockpit were consistent with the system failure. In the light of the evidence of a genuine malfunction, the two men adopted a more relaxed manner and we exchanged flying banter for a time. It was agreed that I could return to base without the cold air system which, because of the failure, would be isolated by the engineers.

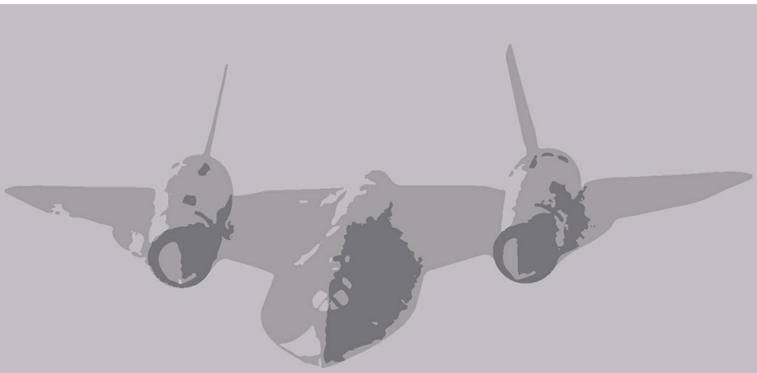
One of the hosts looked at his watch and invited me to follow him outside. We stood in the baking midday sun at the edge of a large dispersal pan where there were two aircraft parked, an F-104D Starfighter and a F-101B Voodoo, both of which were two-seaters. There was an audible deep engine noise that wasn't generated by either the J79 of the F-104 or the two J57s of the F-101, but there was no sign of any other aircraft. A few minutes later the F-101 started its engines and my host then said, 'You'll be interested in this'.

The doors of the 'hangaret' opposite opened to reveal the source of the earlier unidentified engine noise. It was an aircraft pointed straight at our position, which I was to identify later as the forerunner of the SR-71. This sleek black shape then emerged from its cover, passed us while taxiing to the end of the runway and took off with the Voodoo in pursuit. Naturally as a young flight lieutenant I was awestruck to have been so close to this spectacular product of the Lockheed Skunk Works.

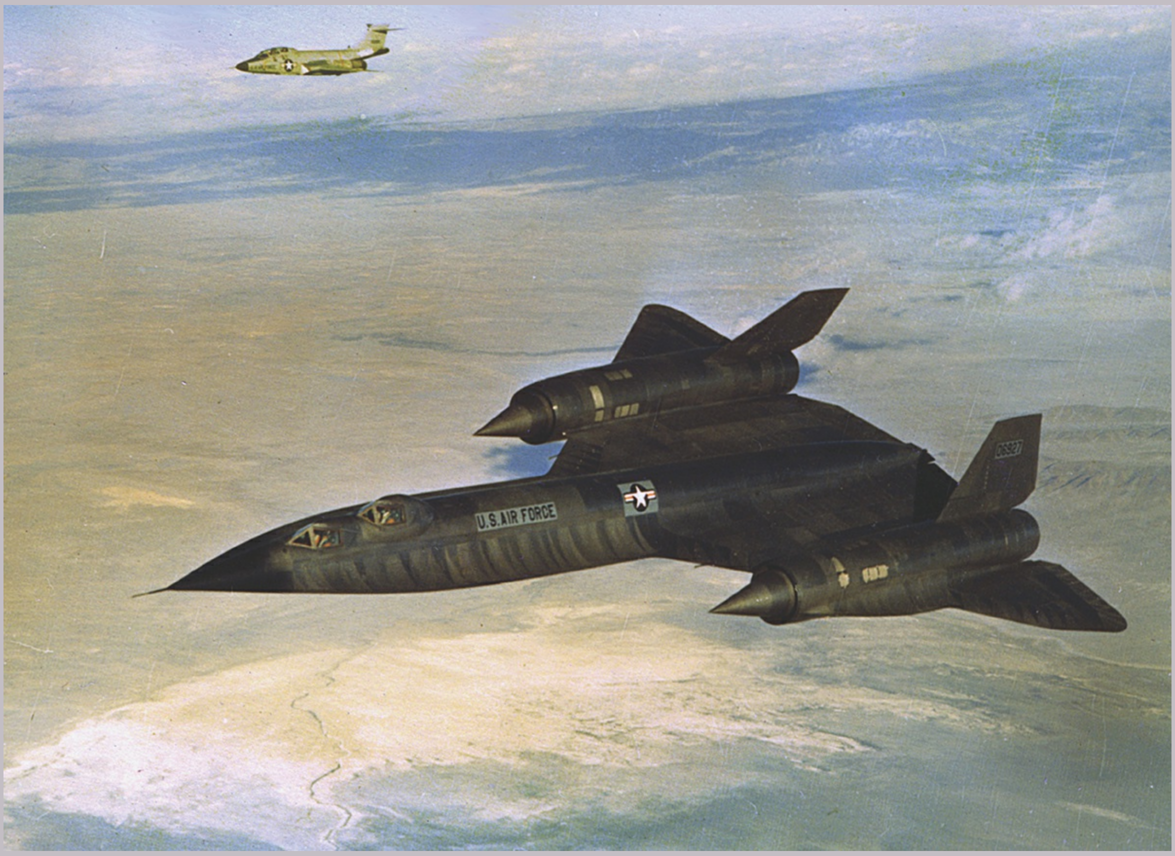
After a quick snack lunch I was returned to reality because my aircraft was pronounced ready to fly and it was time to leave the remote test site and fly back to Nellis. After a final word from my host of the need for complete discretion I boarded my Thud, started the engine, taxied to the end of the runway and took off for the short flight back to Nellis. Because of the lack of air conditioning, I climbed to a relatively cool 10,000ft and turned my back on The Ranch, conscious that I was privileged to have been there.

The following day I was flying another Thud on the same bombing range with a student flying on my wing when he suffered a fuel transfer emergency and again the procedure for such a failure was to land as soon as possible. When asked by the air traffic control tower at the test site to pass my flight details on the emergency frequency, I said merely 'same as yesterday'. I was told that I could return to Nellis after monitoring my student's landing. Perhaps the authorities had seen enough of the visiting Scot at The Ranch and two days running was too much!

This group of Oxcart personnel includes (from left to right) Jack Layton, Dennis Sullivan, Mele Vojvodich, Lt Col Burt Barrett, Jack Weeks, Ken Collins, Walt Ray, General Ledford, Bill Skliar, Lt Col Cy Perins and Cols Holbury, Kelly and Slater. (CIA)



CHAPTER 5: PROGRESS AND POLITICS



Article 124 was the only two-seat pilot trainer to have been built. It was powered by two J75s throughout its life, which restricted it to Mach 1.6 and 40,000 feet, negating the need for crewmembers to wear a pressure suit. (Lockheed Martin)

POSSIBLE EARLY MISSIONS

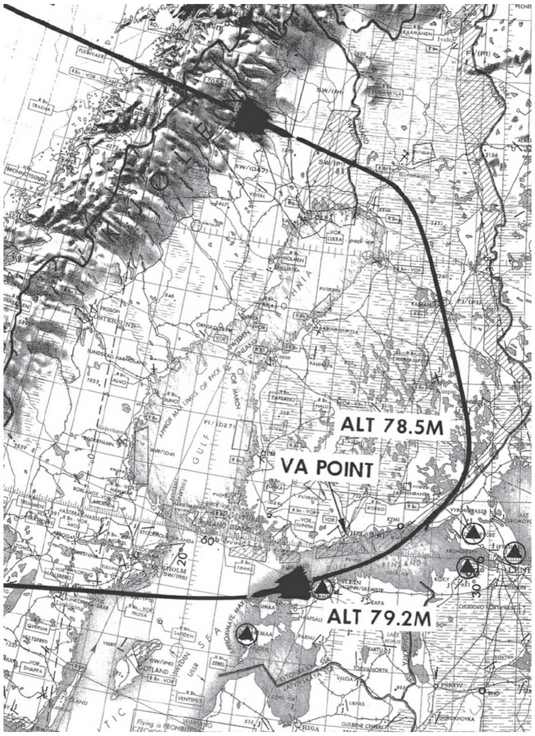
On 1 January 1964, unique equipment used to support the A-12 and stored at Mira Loma Depot was moved to San Bernardino Air Materiel Area, Norton AFB, California. Concurrently, Air Logistics Command at Wright-Patterson AFB assumed full manpower and logistics control at the depot for Oxcart, the D-21 drone project (Tagboard) and the up-coming Air Force Senior Crown programme.

Later that year, KH-4 Corona satellite imagery obtained evidence of what some intelligence analysts believed was an anti-ballistic missile site at Tallinn, Estonia. Photo-interpreters contended that 12-to-18in. resolution imagery was needed to determine the size of the missile, the antenna pattern and configuration of the engagement radars associated with the so-called Tallinn system. The limited resolution of satellite, or 'overhead' imagery at that time, could not produce the required level of detail to resolve the debate.

To settle the issue, the Office of Special Activities (OSA) proposed that a composite mission should be flown consisting of an Oxcart equipped with a high-resolution camera and a U-2 configured for gathering ELINT. The highly classified proposal codenamed Project Upwind had the unclassified codename Project Scope Logic. The A-12 would fly from the United States over the Baltic Sea, where it would coordinate with the U-2. It would then proceed to the north of Norway before heading south along the Soviet-Finnish border. Just prior to reaching Leningrad, the A-12 would head west-southwest down the Baltic Sea, skirting the coasts of Estonia, Latvia, Lithuania, Poland and East Germany, before heading back west to the United States. The 11,000-mile flight would take eight hours 40 minutes to complete and require four air refuellings.

Although it would not violate Soviet airspace, it was hoped the high-speed, high-altitude target would provoke Soviet radar operators into activating the Tallinn system. The A-12, with its Type 1 camera, would secure high-resolution imagery of the Tallinn site and the more vulnerable U-2 would stand off beyond SA-2 range, recording the radar's signal characteristics. Clearly the implications of such a mission required sign-off from the highest levels of government. The Agency and DoD officials supported the proposal, but Secretary of State Dean

Rusk was strongly opposed and the influential 303 Committee never forwarded the proposal to President Johnson for his approval.



Project Upwind was an early, innovative proposal that if authorised, would have seen an A-12 operate in concert with a U-2. (CIA)

Another possible area of operations for Oxcart was Cuba. By early 1964, project headquarters had already begun planning for possible 'contingency overflights' under a programme codenamed Skylark. Four of the 13 A-12s now at Area 51, Articles 125, 127, 128 and 132, were initially designated as primary Skylark aircraft. They were later joined by aircraft 129 and 131 following modifications.

A luncheon meeting held on 15 September 1964 in Secretary of State Dean Rusk's dining room and attended by Secretary of Defence Robert McNamara, National Security Advisor McGeorge Bundy and Director of Central Intelligence McCone, discussed the limitations of satellite coverage of Cuba in the context of monitoring assurances made by the Soviet Union not to redeploy nuclear missiles on the island following the 1962 crisis.

The discussion also covered the vulnerability of the U-2 to undertake such missions in the light of a very real SAM threat. It was pointed out that Oxcart overflights would be ‘far less vulnerable than the U-2, but not entirely invulnerable, however, because of the sonic boom in addition to radar detection.’ McNamara took a slightly opposing view, believing the vulnerability of the A-12 would only increase: ‘if we engaged in frequent flight over a pre-determined pattern the Cubans might put some of their SAMs in a state of alert which would very possibly catch an Oxcart.’ However, he thought that one flight every 30 days would provide enough coverage of the island to fulfil the United States Intelligence Board (USIB) requirements.

Others in attendance disagreed, particularly on the number of sorties required, given a study of the weather over Cuba, especially if substantial coverage of the island was to be achieved. It was agreed that the subject should receive further study, and that this should include Oxcart vulnerability under the Skylark programme and a substantive judgement as to the number of flights required from November 1964 to November 1965 in order to accomplish acceptable coverage of the island with usable photography.

To bring the A-12s up to the standard required to participate in the envisaged missions, a two-point plan was developed. Phases I and II were to begin simultaneously on 1 March 1965. Phase I focused on increasing the aircraft’s regular speed envelope out from Mach 2.9 to Mach 3.05. Phase II concentrated on proving Oxcart’s ability to undertake three air refuellings during the course of a mission, while an element codenamed Supermarket related to improvements in the A-12’s ECM system. Perfecting the latter seemed to be taking a disproportionate amount of time, causing the CIA to try a different approach. This led directly to project Kempster.

Tests demonstrated that a vertically polarized radar wave aimed at the front of the A-12 would couple with the aircraft’s inlets, causing energy to flow along the outside of the nacelles, reflect from their rear section and travel forwards again before being re-radiated towards the radar head. Theory suggested, however, that if a cloud of ionized gas could be created around the A-12 using a particle accelerator, the aircraft would be rendered invisible to radar.

The Agency hired Nick Damaskos to head Kempster, a project pursuing the ionization technique. Design and construction of the equipment was contracted to Westinghouse Research Laboratories and the contract began on 3 June 1963. The project progressed into experimentation to determine the power of the beam that would be necessary to produce the required amount of attenuation.

Initially, test equipment installed in the Q-bay of an A-12 sent an electron beam downwards from the fuselage, blocking transmission from an antenna behind the beam. This proved successful, so a new version was built that sent a beam sideways from the chine in front of the inlet, ionizing air before it reached the inlet. However, the system required virtually all the power generated by the aircraft to work. The electron beam was pulsed on and off 100 times per second, causing the radar return to switch at the same rate between its normal high return and a lower amount.

The system was installed in Article 126 and, after successful testing on the pole at Area 51, was flight tested in October 1963. By December 1964, flights were being made in Article 131. They revealed that every time the electron beam pulsed on, the radar return from the inlet dropped by a substantial amount. This prompted the design to be progressed to an operational version that could run continuously while taking up less power and space.

Phase I of Kempster concluded in March 1965. Money from the NRO-financed Phase II was used to develop four operational prototypes and, additionally, to perform further studies. On 3 August 1966, ELINT specialists from the CIA's OSA, together with its deputy director, John Parnagosky, reviewed progress to date and noted cost overruns and schedule slips. However, this ground-breaking technology had applications way beyond Oxcart and the group therefore recommended extra funds be made available and that additional funding be procured from the NRO to fund Kempster B, a new Westinghouse theoretical study. But Carl Duckett, the CIA's Deputy Director for Science & Technology (DDS&T) rejected the proposals. Within the Agency, the package was known as Catnap and considered as part of an upgrade package for an A-12B follow-on, but Oxcart was cancelled and the upgrades never happened.

In the event, alternative modifications proposed for Skylark provided the A-12 with the required capability. In the interim, on 5 August 1965, the Director of the NSA, Gen Marshall S. Carter, directed that Skylark was to achieve emergency operational readiness by 5 November. Should security considerations dictate, any contingency sorties would have to be executed below the optimum capability of the A-12 (nearer to Mach 2.8); in order to meet this tight timeframe, the Oxcarts would have to deploy without their full ECM suite. Despite the difficulties, a limited Skylark capability was ready on the date prescribed.

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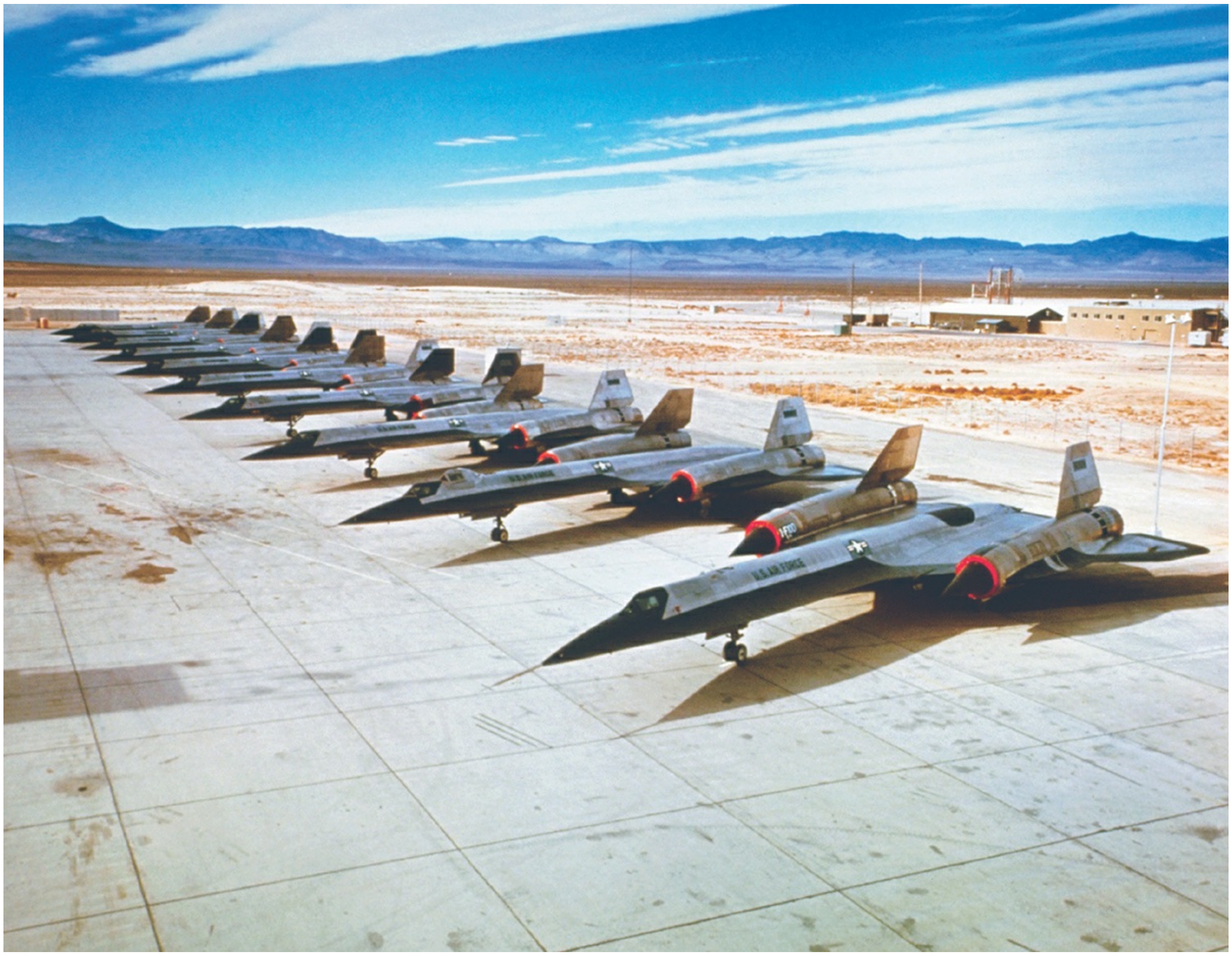
Still wearing the early black and bare titanium paint scheme, Article 130 successfully completed its first flight on 27 November 1963. (Lockheed Martin)

PROVING FLIGHTS

On 27 January 1965, the first in a series of long-range, high-speed, high-altitude proving flights codenamed Silver Javelin occurred. Article 129 completed the 2,580nm flight in just one hour 40 minutes, one hour 15 minutes of which was spent at speeds above Mach 3.1, while cruising altitudes between 75,600 and 80,000ft were achieved. On 18 March, the CIA and DoD leadership agreed to take preparatory steps towards operating the A-12 over Communist China and by year's end all the Agency's project pilots were Mach 3 qualified.

On 22 March, Brig Gen Jack Ledford briefed Deputy SecDef Cyrus Vance on Project *Black Shield*, the planned operational use of Oxcart over North Vietnam in response to the increased SA-2 threat facing the U-2 and Firebee drone reconnaissance vehicles used over Communist China. Overflights of China would obviously have to be approved by the president, but Secretary Vance was willing to make $3.7 million available to provide basing and support facilities at Kadena AB, which were to be ready by autumn 1965.

On 3 June 1965, SecDef McNamara consulted with the Under Secretary of the Air Force on the build-up of SA-2 missile sites around Hanoi and the possibility of substituting A-12s for U-2s on recce flights over the North Vietnamese capital. He was informed that *Black Shield* could operate over Vietnam as soon as adequate aircraft performance was validated.



Parked on the north ramp at Area 51, this shot was taken in late 1963. The line-up consists of seven single-seat A-12s, the 'Titanium Goose', and, at the far end, the first two YF-12A interceptors. (Lockheed Martin)

Six months later, on 20 November 1965, the final stage of the Silver Javelin validation process was completed when a maximum-endurance flight of six hours 20 minutes was achieved, during which the A-12 demonstrated sustained speeds above Mach 3.2 at altitudes approaching 90,000ft.

In the days immediately following a meeting held on 24 November, General Jack Ledford received written assurances from Pratt & Whitney, Perkin-Elmer, Honeywell and Lockheed that all A-12 systems for which they were responsible were now ready for operations. In this memo, Kelly Johnson added:

> The use of electronic countermeasures gear, combined with the very low radar cross section of the aircraft, will make it a very difficult target to be handled by a surface-to-air missile. Also, I do not know of any aircraft in the world today which can successfully intercept the Oxcart aircraft. Over-all, my considered opinion is that the aircraft can be successfully deployed for the Black Shield mission with what I would consider to be at least as low a degree of risk as in the early U-2 deployment days. Actually, considering our performance level of more than four times the U-2 speed and three miles more operating altitude, it is probably much less risky than our first U-2 deployments. I think the time has come when the bird should leave its nest.

On 30 November 1965, Kelly logged, 'As of this date we have three aircraft that are operational. We were instructed to maintain a degree of readiness so the aircraft could be deployed in two weeks.' Two days later, Alexander Flax, Director of the National Reconnaissance Office, sent a memorandum to the Special Assistant to the President for National Security Affairs, the Deputy Secretary of State, the Deputy Secretary of Defense and the Director of Central Intelligence, entitled Oxcart Far East Deployment – Carousel, within which he recommended that the 303 Committee should 'consider the appropriateness of Oxcart deployment to Kadena at this time'. However, following an 'extensive and detailed discussion' by the committee on 3 December, the proposal was rejected. It was agreed however, that all steps should be taken to develop a quick-reaction capability for deploying the A-12 reconnaissance system within a 21-day period any time after 1 January 1966.

During a 303 Committee meeting that took place on 28 March 1966, consideration was again given to the immediate deployment of Oxcart to Kadena. This CIA recommendation was based upon the intelligence communities' 'requirements which were not being satisfied at this time through the other available methods, ie KH-7 (satellite photography), TROJAN HORSE [SAC U-2] BLUE SPRINGS [high altitude Ryan Model 147H Remotely Piloted Vehicles – RPVs or drones] and IDEALIST/TACKLE [CIA U-2] flights'. Based upon the paucity of intelligence and his responsibility as DCI to supply answers, Admiral Raborn (who had replaced John McCone as DCI in April 1965) was unsurprisingly pro deployment. However, a split between the JCS (pro deployment) and Secretary of Defence McNamara and Secretary of State Vance enabled U. Alexis Johnson (US Ambassador to the Republic of Vietnam), to sum up the meeting by saying, 'since the DoD were the principal customer and were willing to live with lesser coverage', he could accept that and the committees's conclusion not to deploy at this time, but 'that current opinions on Oxcart be brought to the attention of higher authority [President Johnson], by the two Secretaries and Admiral Raborn at an early date'.

Two months later, the 303 Committee meeting held on 11 May 1966 again discussed various aspects regarding the deployment of Oxcart to the Far East. This time they included the likely requirement to increase reconnaissance coverage of North Vietnam, following any decision to include strikes against the country's Petroleum Oil and Lubrication (POL) installations. It was also noted that Oxcart's deployment to Okinawa would require prior understanding of possible problems with Japan, given its traditional proprietary interests in the island. Once these details had been addressed, it was agreed that the committee would be in a better position to pose the entire issue to 'higher authority.'

On 12 May 1966, Kelly recorded in his log, 'As of this date, there is still no go-ahead for the deployment, although it seems fairly optimistic. The airplanes are ready to go. We do not yet have the range up to the design value, but ⅔ of the loss has been due to weight changes due to added equipment. ⅓ of it is due to loss in range cruising. We can do about 3,000nm, but they, of course, do not get the range that we can.'

Following a 303 Committee meeting held on 24 June 1966, it was agreed that the continuing divergent views concerning Oxcart deployment would be presented:

> To higher authority. The line-up is approximately as follows: The CIA is in favour of deployment and use at this time. The State Department is against. The Department of Defense is split to the extent that Secretary McNamara and Mr. Vance oppose deployment at this time, whereas the Joint Chiefs of Staff are in favour of deployment and use at this time to satisfy requirements of targets in South China. The President's Foreign Intelligence Advisory Board is on record as favouring deployment and use at this time.

It went on to note:

> There seemed to be some ambiguity about where the United States stood officially on overflights of China. At a news conference on 27 May 1966, Secretary Rusk replied in answer to a question that 'They [U.S. pilots] have instructions not to intrude into Chinese airspace' and later in the same conference, 'It is true that we do not instruct our pilots to overfly China'.

On 12 August 1966, a letter was sent from the White House to the DCI stating that, 'The President has decided for the time being that Oxcart will not be deployed. In order to minimize the time lag in bringing Oxcart to bear during an emergency, would you be good enough to consider with Secretary McNamara measures that might shorten the present estimated 21-day deployment interval'.

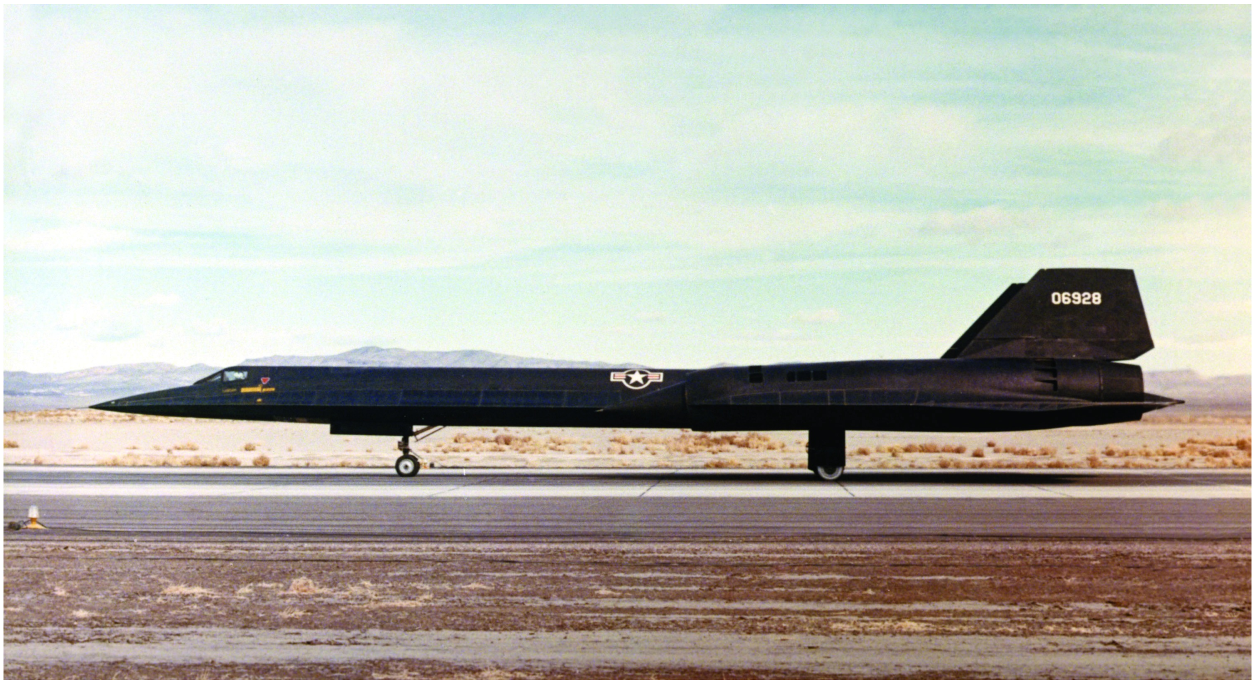
Three days later Kelly noted, 'We do not yet have permission to deploy, although this looks a little more favourable now. Our morale is poor, as there seems to be no direction to the program.'

Meanwhile, training and testing continued, while mission plans and tactics were also prepared to ready the operational 'package' for deployment should Carousel, the Black Shield deployment plan, be executed. In line with the president's request, deployment timing was cut from 21 to 11 days and the base maintenance facility at Kadena AB was stocked with support equipment. To further underwrite the A-12's capability to carry out long-range reconnaissance missions, Bill Park completed a non-stop 10,200-mile flight in just over six hours on 21 December 1966.

ARTICLE 125 IS LOST

Fifteen days after Park's proof-of-range flight, on 5 January 1967, tragedy struck the programme with the crash of another jet; this time the incident claimed the life of its pilot. Walt Ray had logged 358 hours in the A-12 when he got airborne from Area 51 at 11:50am (local time) using his personal call sign Dutch 45, in Article 125.

The mission was scheduled as a routine training and test sortie, and shortly after take-off Ray successfully completed his first AR, taking on board 36,000lb of fuel. Completing the first high-speed, high-altitude leg of the sortie, he descended for a second AR; this time his fuel on-load was 61,000lb. This was 4–5,000lb less than planned, since the tanker reported it was running low on gas. To make up for the shortfall, Walt planned to execute a fuel saving, reduced-power climb during the next leg; his fuel management skills seemed to have paid off when, having completed his final turn back to home plate, he was a manageable 800–1,000lb off schedule.



Article 125 was lost on 5 January 1967 during a training/test flight; its CIA pilot Walt Ray was tragically killed when he failed to separate from his seat after ejecting. (Lockheed Martin)

However, nearing Framington, New Mexico, the aircraft should have had about 13,000lb on board, but at 3:22pm Walt reported that he was down to 7,500lb and commented on the radio transmitter (R/T), 'I don't know where it's gone'. Thirty minutes later, during the descent near Hanksville, Utah, he reported that he was low on fuel and just one minute later he declared an emergency. At 3:56:27pm, Walt radioed that he was 130 miles out, had just 4,000lb of fuel left and that he was losing it at an excessive rate. Five minutes later he reported that the fuel low-pressure lights had illuminated. After 30 seconds he reported that the engines were flaming out.

At 4:03pm Walt made his final radio call, stating that both engines had flamed out and he was ejecting. Article 125 (60-6928) had run out of fuel 70 miles short of Area 51. After 'gliding' to a lower altitude and executing what appeared to be a controlled ejection, Walt failed to separate from the ejection seat and was killed when he hit the ground.

POST SCRIPT

The accident investigation board concluded that the cause of the accident was a ‘probable fuel gauge error’. However, the circumstances leading up to the loss of this outstanding pilot and extremely popular member of the programme were particularly ironic. Almost a year earlier, on 25 January 1966, SR-71A test vehicle ’952 had been lost by Lockheed flight test crew Bill Weaver and Jim Zwayer during a range-extension test in which Zwayer was killed. Post-accident investigation revealed that the back-seater had died from a broken neck, sustained as the aircraft disintegrated following a Mach 3 pitch-up.

The violent whiplash that resulted from the high-speed break-up of the aircraft, and the G-forces that slung Zwayer and Weaver about as they were forcibly torn from their non-ejected seats, slammed Zwayer’s head back against the headrest. It was further determined that because of Zwayer’s short stature, his headrest was further back due to the thickness of the parachute’s backpack.

Subsequent to that accident, Lockheed undertook flight-safety modifications to the seat’s headrest cushion, tailoring it more closely to the contours of individual crewmembers to provide support and protection from future whiplash injuries. Walt’s extended headrest had caused his parachute to become trapped between the seat well and the headrest so that the ‘butt-snapper’ straps (which had attempted to work as advertised) couldn’t push Walt free of his seat. The accident was a bitter blow to the deployment timing of Oxcart. The *Los Angeles Times* reported the accident and identified the aircraft as an ‘SR-71 Experimental Reconnaissance jet’ and Walt Ray as a ‘Lockheed test pilot’.

DECISION TIME

Following a presidential luncheon meeting on 11 May 1967, the detection of offensive missiles in North Vietnam was discussed and the president asked for a proposal. In response the CIA prepared an overnight memorandum that was distributed amongst the 303 Committee for a meeting the next day (12 May). The discussion took the form of a briefing, which was presented in two parts. The first part encompassed Coverage Requirements and is quoted here verbatim:

> The primary requisite is, of course, nearly complete coverage of North Vietnam with particular attention to those priority areas where the emplacement of offensive missile systems is considered most likely. Ideally it would be desirable to obtain thorough coverage of the important rail transloading yards of Pingxiang and Kung Ming in China in order to detect possible introduction of offensive missiles at the earliest possible date i.e. while they’re in transit. This may be politically undesirable.

> Therefore, this operational proposal confines itself to the likely areas in North Vietnam including marshalling yards and spurs in the North Vietnamese rail system as well as the port of Haiphong. A second requirement is that the coverage be repetitive. This is essential in order that new activity or changes in the nature of previously observed activity can be detected promptly. A third and equally important requirement is adequate resolution to identify different types of missiles or missile-associated equipment. Resolution on the order of 2-1/2 to 3ft is needed to distinguish between missiles and missile-associated ground support equipment and other hardware such as armoured vehicles and transport equipment.

An unidentified A-12 lines up on the Area 51 runway, closely followed by F-101B chase aircraft. A second A-12 can just be seen undergoing pre-flight checks the other side of the 'blast wall'. (Lockheed Martin)

The next element of the briefing concerned Current Coverage. High-resolution satellite coverage was provided by KH-7 and KH-8 satellites. However, difficulty was expressed in scheduling satellite coverage to coincide with favourable weather conditions. Furthermore, stereo coverage (vital for providing Photo Interpreters with image measurements) was limited to nine miles width for the KH-7 camera and five miles for the KH-8 system. Additionally, because of constraints of the high-resolution systems, only a few high priority targets could be image on any one mission. The KH-4s provided wider panoramic coverage of about 160 miles, but again prevailing weather conditions often shrouded the country in cloud. Furthermore, whilst the lower resolution system could locate a missile site, it could not provide sufficient image resolution to establish the identification of specific missile types.

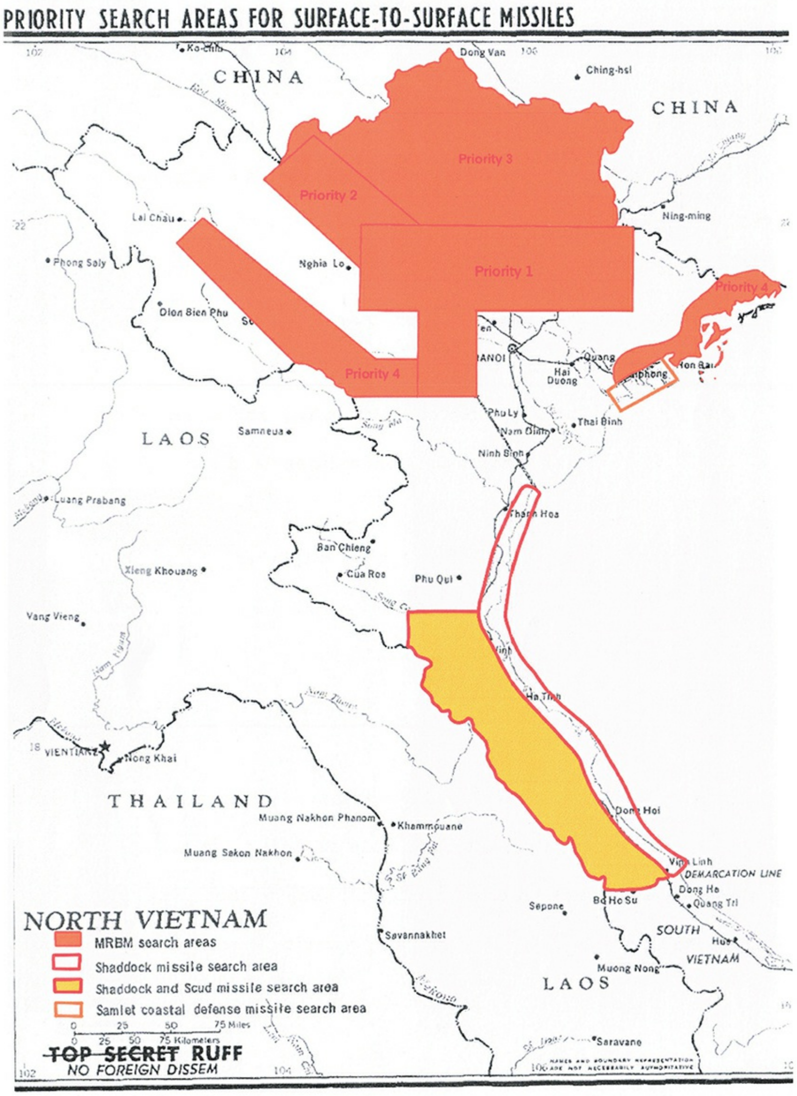
High-altitude U-2 camera systems were capable of providing the required image resolution; however, since the introduction of SA-2s into North Vietnam in the spring of 1965, and the platform's vulnerability to this weapons system, U-2 operations had been restricted to areas to the north west of the country, thus imposing serious operational limitations.

Coverage by combat reconnaissance ranged from between 30,000ft and 500ft and image quality was assessed as ranging from excellent to poor. The National Photographic Interpretation Centre (NPIC) reported receiving photography from between 800–900 missions in 1966 and up until April 1967, 750 missions a month. It stated that about 20–25 per cent of this was either infrared or side-looking radar – that was not applicable for missile identification. Also, the short film strips, produced for point targets, weren't conducive for area search operations.

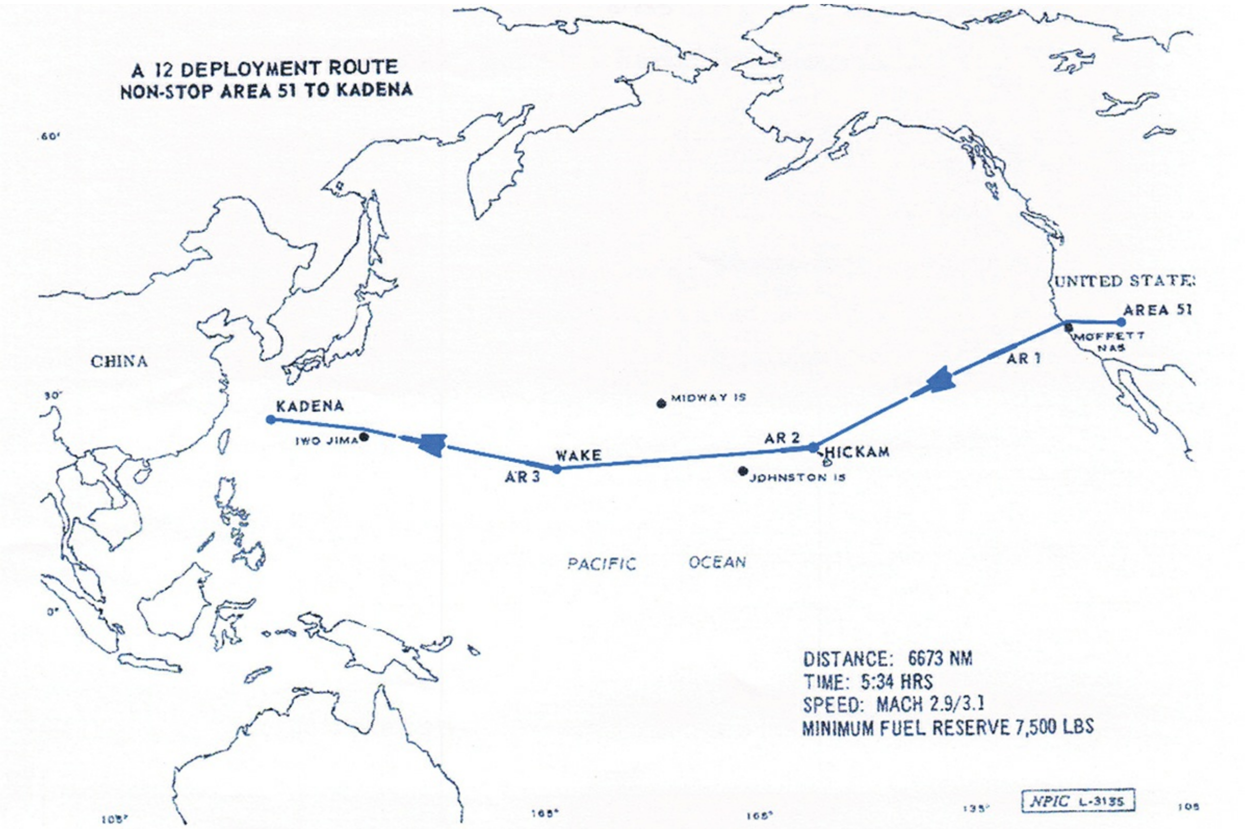
Finally, it was stated that although low-level drones flown at 1,500ft provided excellent imagery, their low altitude restricted usable photography to about one mile either side of the drone's track. The high-level drones, flown at 60,000ft, were vulnerable to SA-2 attack and of the 12 that had been flown to date, only five had been recovered. Therefore, for different reasons, neither drone types were capable of providing timely, repetitive photographic coverage of the sites identified for IRBM reconnaissance missions.

The briefing stated that four priority search areas for Surface-Surface-Missiles (SSMs) (see map) had been established by the Lookout Task Force in 1966 (the task force had been set up in February 1966, specifically to look for the possible introduction of any new weapons, especially surface-to-surface missiles in North Vietnam) and as a result, those designated areas had been receiving additional study. These search areas, particularly for fixed-site medium range missiles, were based upon the need for an adequate road network and the suitability of terrain for the emplacement of the site for masking or camouflaging. A secondary consideration was the availability of air defence protection, particularly SA-2s.

The briefing's second part was entitled Oxcart Reconnaissance Operations Plan and delivered by Brig General Paul Bacalis (Director of Special Projects, Central Control Group). He stated that the photographic coverage would be accomplished by Oxcart operating from Kadena AB, which had been ready for some time. Operational missions would be planned, directed and controlled by the CIA utilizing three A-12s and support personnel drawn from Area 51. With this inventory, it was envisaged that a minimum of nine successful operational missions could be flown consistent with available weather. The plan recognized that overcast skies were a predominant feature associated with the monsoon season, thereby limiting the number of days for effective photo reconnaissance. The missions would be launched on a 24-hour alert basis, thus permitting maximum utilisation (it was hoped), of favourable weather conditions. In addition to the operational missions, necessary test and proficiency sorties would also be flown from Kadena. Oxcart aircraft would be rotated between Area 51 and Kadena to ensure that the required number of operationally ready aircraft at Kadena were maintained. It was anticipated that the first operational mission would be flown 15 days after approval of implementation of the plan. The briefing further detailed that the Oxcart would be flown non-stop from Area 51 to Kadena with three aerial refuellings enroute, which would be supported by tankers operating from Beale AFB, Hickam AFB, Hawaii and Kadena AB. Each operational mission would consist of two aerial refuellings and coverage could include the majority of SA-2 defended areas north of the Demilitarized Zone on one mission. Photographic resolution would be from 1ft to 3 ½ft and the briefing ended with the statement that, 'The Oxcart vehicle is virtually invulnerable to SA-2 and other defensive systems in North Vietnam because of its high operational altitude, high speed and the Electronic Counter Measure systems installed'.


PRIORITY SEARCH AREAS FOR SURFACE-TO-SURFACE MISSILES
CHINA
CHINA
Priority 3
Priority 2
Priority 1
Priority 4
Priority 4
Lai Chau
Phong Saly
Nghia Lo
Dien Bien Phu
HANOI
Hai Duong
Haiphong
Hon Gai
Ning-ming
Ching-hsi
Dong Van
Ko-chiu
Phu Ly
Nam Dinh
Ninh Binh
Thai Binh
Thanh Hoa
LAOS
Samneua
Luang Prabang
Ban Chieng
Cua Rao
Phu Qui
Xieng Khouang
Vang Vieng
Vinh
Ha Tinh
VIENTIANE
Nong Khai
THAILAND
Muang Nakhon Phanom
Khammouane
Muang Sakon Nakhon
Dong Hoi
Vinh Linh
DEMARCATION LINE
Dong Ha
Quang Tri
Hue
SOUTH VIETNAM
Sepone
Bo Ho Su
Savannakhet
Muong Nong
LAOS
Saravane
Mekong
NORTH VIETNAM
MRBM search areas
Shaddock missile search area
Shaddock and Scud missile search area
Samlet coastal defense missile search area
0 25 50 75 Miles
0 25 50 75 Kilometers
~~TOP SECRET~~ RUFF
NO FOREIGN DISSEM
NAMES AND BOUNDARY REPRESENTATION ARE NOT NECESSARILY AUTHORITATIVE
102
104
106

Areas of special interest as identified by the Lookout Task Force. (CIA, Enhancement and Colourization by Doug Fawkes)


A 12 DEPLOYMENT ROUTE
NON-STOP AREA 51 TO KADENA
60°
CHINA
30°
0°
KADENA
IWO JIMA
AR 3
WAKE
MIDWAY IS
AR 2
HICKAM
JOHNSTON IS
AR 1
MOFFETT NAS
AREA 51
UNITED STATE
PACIFIC OCEAN
DISTANCE: 6673 NM
TIME: 5:34 HRS
SPEED: MACH 2.9/3.1
MINIMUM FUEL RESERVE 7,500 LBS
NPIC L-3135
105°
165°
165°
135°
105

Oxcart operational deployment map. (CIA Enhancement and Colourization by Doug Fawkes)

A second luncheon meeting was held with President Johnson on 16 May during which the president gave his approval for the immediate deployment and use of Oxcart. The deployment to Kadena AB from Site 51 was expected to take between 13 and 15 days. Consequently, the detailed deployment plan was immediately put into action. Given Oxcart's unique appearance together with the sensitivity of the mission, on 29 May 1967 Acting Director of Special Activities John Parangosky sent a memorandum to the Interdepartmental Contingency Planning Committee, entitled Contingency and Cover Plan for Black Shield Operations: no fewer than 28 people were copied in on the distribution list. It noted that the mission was to obtain high-resolution photographic coverage of priority targets in North Vietnam utilizing the A-12, staging from Kadena, but does not include overflight of mainland China. Furthermore, the overflight operations were to be conducted, 'with the least amount of publicity… conceal intelligence community (particularly CIA) participation in the development and utilisation of the A-12, [and it provided],

…herein guidance and procedures to be adhered to should the following situations occur'.

The memo then detailed the process to be followed in four different scenarios. If a formal inquiry concerning the identity of the aircraft operating from Kadena was made, 'the Kadena Public Information Officer will state that they are experimental test bed versions of the YF-12A and SR-71 family…undergoing field tests.' Should protests arise following a successful overflight without incident, '…all personnel in the field will disclaim any knowledge of the overflight.' If, however, such protests were directed at US ambassadors, 'They will neither disclaim nor acknowledge awareness of any overflight and refer such queries to the State Department.' If these queries were directed to government officials in Washington, '…the initial response will be "No Comment".' If an Oxcart was lost over North Vietnam, Laos or Mainland China, either through mechanical failure or hostile action, '…no statement will be volunteered until there has been a full evaluation by the 303 Committee of the circumstances surrounding the incident and the political ramifications…After evaluation, the 303 Committee will authorize an appropriately worded statement. The sole spokesman for the US Government will be the Department of State.'

Parangosky then suggested to the 303 Committee five possible statements depending upon the circumstances surrounding the Oxcart's loss. Finally, he included instructions that should be briefed to the pilot, should he be forced down in Communist Bloc territory. These stated that,

> he will adhere to the provisions of Headquarters Directive 50-1055-24, dated 27 October 1965 (approved by the 303 Committee 16 December 1965…), which states in essence, that he will give: Name, Date and Place of Birth, Address in the United States and CIA Affiliation (Civilian). In the extremely remote possibility that the pilot should be forced down in Burma or Cambodia, he will not disclose his CIA affiliation. He will state that he is a civilian test pilot ferrying the aircraft from Okinawa to Thailand. His overflight was inadvertent and due to a mechanical malfunction of his Inertial Guidance System. A dummy map of the alleged ferry flight will be carried to backstop his story. He will request that the American Consulate be notified of the situation.

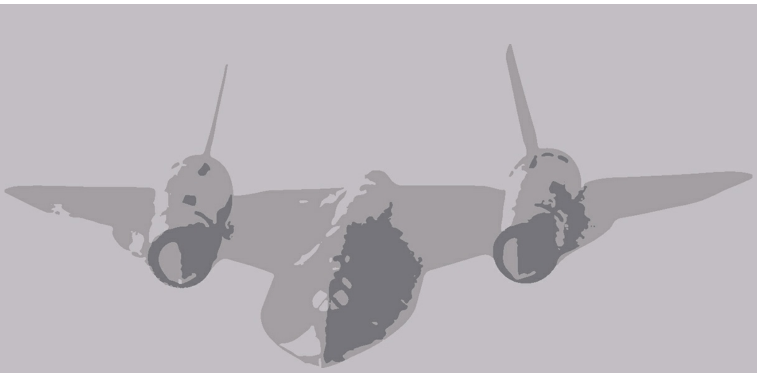
DEPLOYMENT – AT LAST

At 0800 on 22 May 1967, Mele Vojvodich departed Area 51 in Article 131, 60-6937, and headed west across California for his first refuelling. Having topped off, he accelerated to high Mach towards the next air refuelling control point (ARCP) near Hawaii. A third rendezvous took place near Wake Island to ensure he had reserve fuel sufficient to divert from an intended landing at Kadena to either Kunsan AB, South Korea or Clark AFB, Philippines (1,200 miles beyond Kadena), should the weather over Okinawa deteriorate. The weather was fine and Mele let down for landing after an uneventful flight of just six hours, ten minutes. Vojvodich attained an altitude of 79,000ft during cruise at Mach 2.9 for two legs and Mach 3.1 for the other. Had it not been for the deployment's secrecy, the flight could have been recognized as a new transpacific speed record.

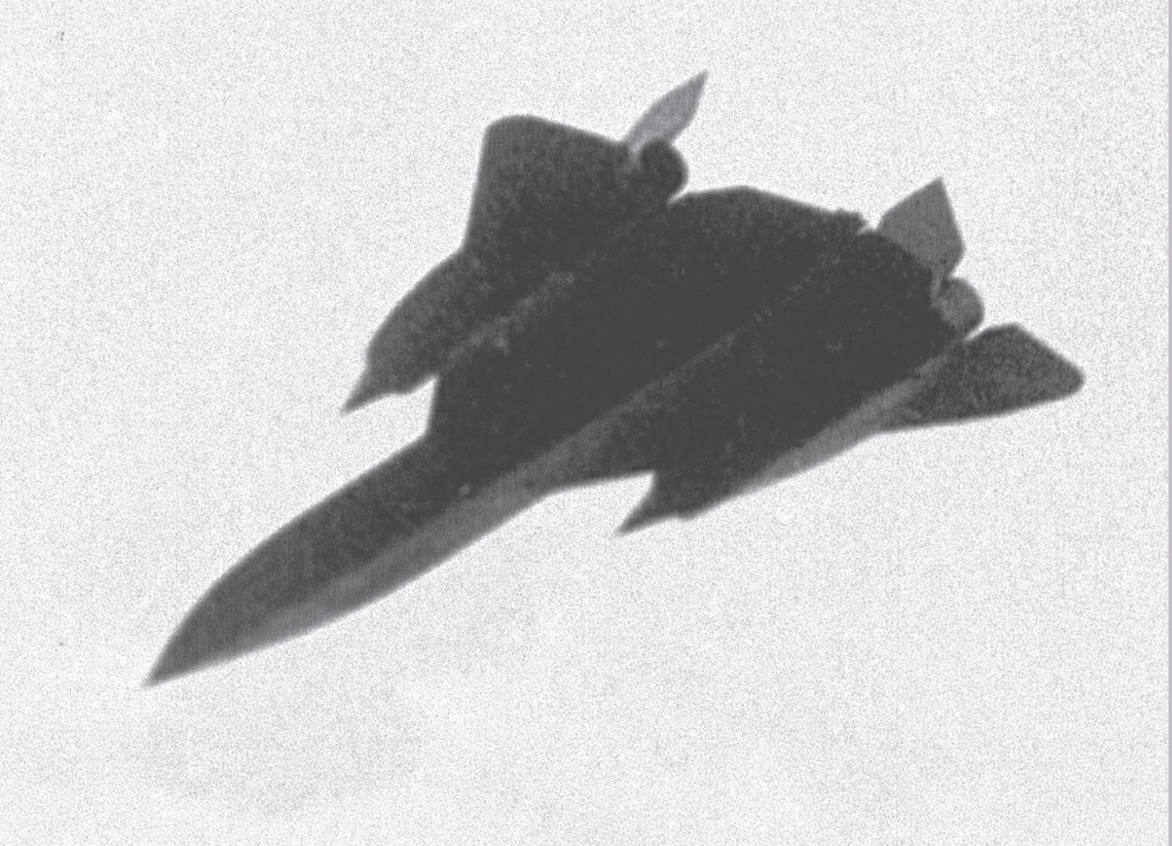
Two days later, Jack Layton set out to repeat Mele's flight, but aircraft 127 (60-6930) experienced an air data computer failure shortly after take-off and Jack lost the important knots equivalent airspeed (KEAS), Mach number and altitude read-outs on his triple display indicator (TDI). Loss of the TDI was an 'abort item' on his 'GO-NO-GO' checklist, but Jack (like all the Oxcart team) was acutely aware of the pressure on the programme to succeed. He therefore chose to continue the flight, calculating bypass door and inlet spike position schedule changes by temperature gauge indications.

That careful action proved successful and Jack landed the second aircraft at Kadena in six hours, during which he reached an altitude of 81,000ft. He was met after engine shut-down by his old flying instructor and now A-12 Det commander, Col Slip Slater, who asked if there were any maintenance write-ups, to which Jack replied, 'Only the TDI'. 'When did you lose that?' Slip pressed. 'A way back,' answered the A-12 driver. 'How far a way back?' continued the colonel. 'Well, just after take-off, actually,' Jack admitted. 'You crazy SOB,' Slip laughed and never again mentioned the incident.

Jack Weeks left Area 51 on 26 May, but due to INS and radio problems the flight was made at Mach 2.9 reaching an altitude of 76,000ft, before he was forced to divert into Wake Island. An Oxcart maintenance team arrived in a KC-135 from Okinawa the following day to prepare 129 (60-6932) for the final 'hop' to Kadena. After completing the journey, Jack's aircraft was soon declared fit for operational service along with 127 and 131. The detachment was declared ready for operations on 29 May and based on data from an in-theatre weather reconnaissance flight the day after, it was determined that conditions over North Vietnam were ideal for an A-12 photo-run. At last, all the pieces were in place.



CHAPTER 6:
BLACK SHIELD



The sensitive nature of Black Shield meant that very few images of the Oxcart whilst at Kadena were taken, consequently those that have are few and not of the best quality. (CIA)

OPERATIONAL MISSIONS

At the end of 1968, the total cost of the Oxcart programme (including development, production, maintenance, operation and support) amounted to $950 million – $7.49 billion in 2023 money. The technologies that it deployed and its capabilities were unmatched. However, under project Black Shield, the Oxcart programme completed just 29 operational missions in 341 days, after which the CIA's involvement in tri-sonic, manned reconnaissance was terminated. During this short timeframe, the aircraft's strengths and limitations were exposed, not just to those directly involved in the programme, but also to an ingenious, resourceful enemy. Recently declassified CIA documents, including routes, briefing documents and information gathered from the Oxcart's electronic intelligence (ELINT) system, its defensive, electronic counter measure (ECM) systems and the communications intelligence (COMINT) network, have at last enabled us to combine these together and provide a detailed study of each of those historic missions, including an appreciation of how tactics and procedures were continually developed by both sets of combatants.

Based upon favourable data from an in-theatre WC-135 weather reconnaissance flight, project headquarters in Washington put Black Shield on alert for its first operational flight on 30 May; the mission was designated BSX-001. Avionics specialists checked systems and sensors, and at 4:00pm local time, Mele Vojvodich and the designated back-up pilot Jack Layton attended a mission alert briefing. This included such details as the projected take-off and landing times, routes to and from the target area, and a full intelligence briefing of the area to be overflown. At 10:00pm (12 hours before planned take-off time), a review of the weather confirmed the mission was still on, so the pilots went to bed to ensure they got a full eight hours of 'crew rest'.

They awoke on the morning of 31 May to torrential rain, a new phenomenon to the 'desert dwelling' A-12s. The two pilots ate a high-protein breakfast, dressed and proceeded to prepare for the mission, despite the rain. Since weather conditions over the 'collection area' were good, at 08:00am Kadena received final clearance from Washington that the mission was definitely 'on'.

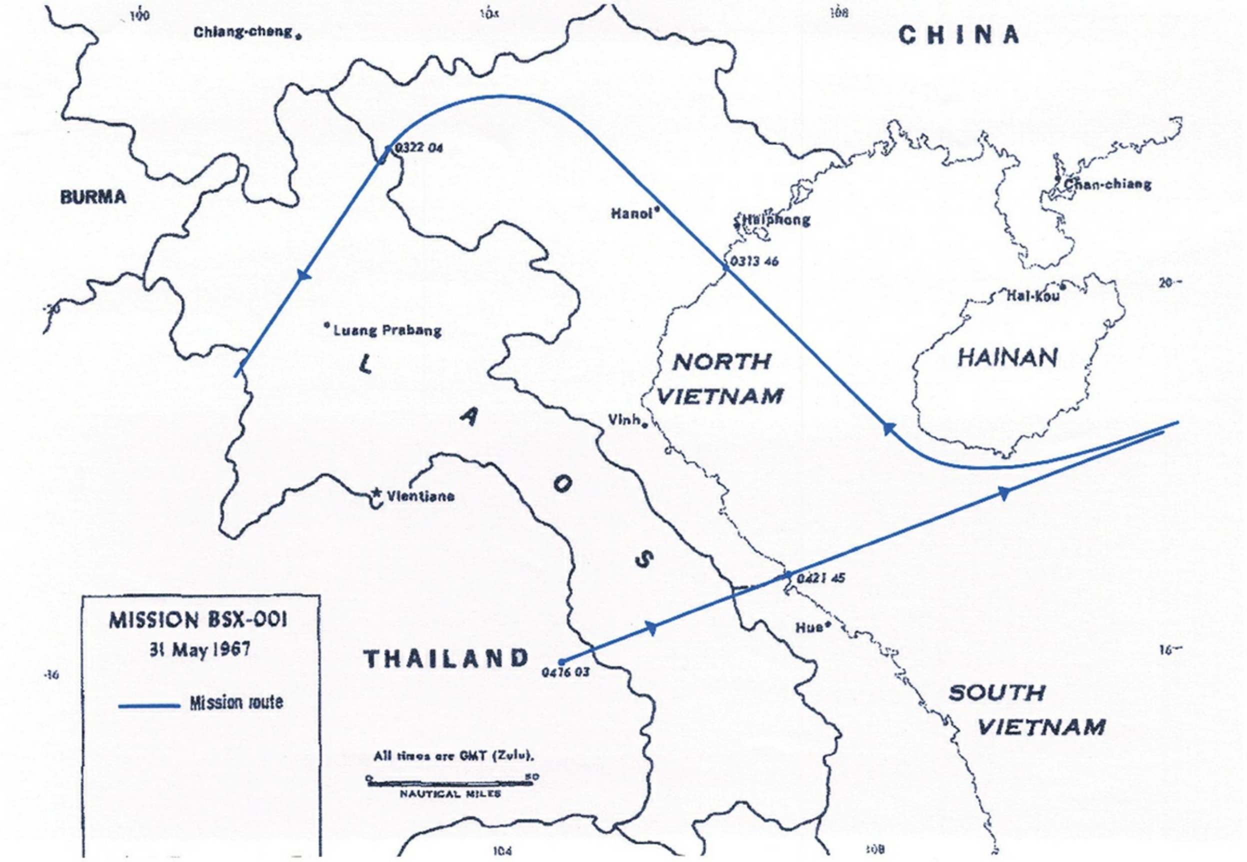
Meanwhile, the rain continued without let-up, casting serious doubt over the launch. The pilots had the final say in the matter, since conditions were within Air Force take-off limits.

Mele Vojvodich successfully completed BSX001 on 31 May 1967. During stateside training sorties, his personal call sign was Dutch 30. (Lockheed Martin)

Vojvodich, well aware of the pressure on the programme to deliver, elected to launch. After brief medical checks, he and Layton donned their S-901 full-pressure suits and began breathing 100 per cent pure oxygen to purge their bodies of potentially harmful nitrogen. By taxi time the rain was falling so heavily that a staff car had to lead Vojvodich from the hangar to the end of the main runway. After lining up for what would be the A-12's first instrument-guided take-off, on cue, Vojvodich engaged both afterburners and accelerated Article 131 rapidly down the runway, quickly disappearing completely into the rain and then upward through the clouds.

Minutes later 131 burst through cloud and continued climbing to 30,000ft whilst making for the Deep Work Air Refuelling (AR) track, just southwest of Okinawa. Having topped off the tanks and disengaged from the boom of the KC-135Q tanker, Vojvodich once again accelerated and climbed to operational speed and altitude, informing Kadena that the aircraft systems were running as per the book and that the back-up services of Layton would not be required.

BSX-001 consisted of a single loop that entered 'denied territory' south of Haiphong (see map), at precisely 03:13Z, (10:13am Local). A second air refuelling took place over Thailand, followed by a climb and acceleration to speed and altitude before initiating a second penetration of North Vietnamese airspace near the demilitarized zone (DMZ). Vojvodich then recovered Article 131 into Kadena, after three instrument approaches made in driving rain.


100
104
108
Chiang-cheng
CHINA
BURMA
0322 04
Hanoi
Haiphong
Chan-chiang
0313 46
Hai-kou
20
Luang Prabang
L
A
O
S
NORTH VIETNAM
HAINAN
Vinh
Vientiane
0421 45
MISSION BSX-001
31 May 1967
Mission route
THAILAND
0476 03
Hue
16
16
SOUTH VIETNAM
All times are GMT (Zulu).
0
50
NAUTICAL MILES
104
108

BSX001. (CIA, enhancement and colourization by Doug Fawkes)

Back in the ‘barn’ the results of the three-hour-55-minute flight were eagerly awaited. The film from the ‘photo-take’ was downloaded and sent by a special courier aircraft to the Eastman Kodak plant in Rochester, New York for processing. The imagery was then sent to photo interpreters (PIs), at the National Photographic Interpretation Center (NPIC), located within the Washington Navy Yard, where it was used to prepare an Initial Photographic Intelligence Report (IPIR).

Despite having been in Vietnamese airspace for just eight minutes and 18 seconds, Article 131’s film take was vast. Close analysis by the PIs was unable to find any evidence of the deployment of offensive surface-to-surface missiles (SSMs); however, a huge number of other potential targets and installations were imaged. They included 70 of the 190 known North Vietnamese SA-2 sites, and the Chinese Naval Base at Yu-lin. In addition, nine of the 27 Committee on Imaging Requirements and Exploitation (COMIREX), Priority I targets in North Vietnam were also photographed.

To gather Electronic Support Measures (ESM), Article 131 was equipped with a so-called Signal Intercept Package (SIP). As previously mentioned, this basic Electronic Intelligence (ELINT) gathering system monitored and recorded information used to piece together the enemy's Electronic Order of Battle (EOB). This could then be exploited by those planning strike missions to avoid active SA-2 sites and also by aircraft tasked with conducting Electronic Warfare (EW). Analysing this system also enabled signals specialists to establish that Article 131 had not been located by the enemy's surveillance radar network. Similarly, neither had any SA-2 Fan Song signals been detected by either the SIP package or 131's Electronic Counter Measures (ECM) system.

Finally, the network of land, sea and airborne listening stations that smothered South-East Asia, manned by US military and National Security Agency (NSA) personnel that gathered Communications Intelligence (COMINT), was able to establish that the enemy had not reported the aircraft's presence over its communications network. Pulling all these intelligence gathering strands together, it therefore became apparent to the 'Oxcarters' that Article 131 had been neither detected or tracked by any Chinese Communist (Chicom), or North Vietnamese radar systems at any point during the mission, and that the aircraft had therefore effectively remained 'invisible to radar' – a prerequisite that had been demanded of the U-2's replacement by President Eisenhower back in 1956.

To establish an accurate baseline from which to evaluate the effectiveness of the A-12's reduced Radar Cross Section (RCS) design in an operational environment, the CIA also tracked and correlated the level of jamming being conducted by US forces during the course of each Black Shield mission. This was to identify if the aircraft benefitted from additional 'electronic masking', generated by other platforms. In this instance, it was noted that Department of Defense (DOD) strike/jamming operations were light, and no EB-66B or EB-66C jamming aircraft were operational during the mission.

Interestingly, during an interview with the author in 1992 (25 years after the event), Mele Vojvodich claimed that several SA-2s had been fired at his aircraft during that first operational mission, adding, 'all of them detonating above and well behind 131'. However, the assiduous nature of the CIA's post-mission investigation and report is at odds with this particular recollection. It could have been that Vojvodich was getting confused with events that occurred during his second Black Shield mission.

Tragedy struck the tightly knitted detachment the next day, when one of its two F-101Bs crashed immediately after take-off. The Voodoos provided Black Shield crews with proficiency training and, at the time of the incident, it was being flown by Lt Col Welton King, the detachment weather officer. A material failure caused the tail section to become detached from the rest of the aircraft. King's subsequent low-level ejection was unsuccessful and he was killed when serial number 56-0272 hit the ground. The aircraft was never replaced.

A duty roster was set up for the six operational Black Shield pilots on the basis that at least two would be required on station at Kadena at any one time. Frank Murray recalls:

> We flew out to the OL on US-flag airlines in First Class, one guy at a time. Some allowance was made if a guy went on holiday and the like, and when it was time for one pilot to be replaced the new guy would fly in a week or two before the other left. We were all housed in an old Quonset Hut housing area called 'Morgan Manor'. The Agency had them overhauled and they were deluxe by anyone's standards, with a fresh coat of paint on the outside, but really well fitted out inside.
>
> A couple of good-sized portable buildings were joined to make the mess hall and offices and it was all located at the adjunct of a major intersection called Kadena Circle, near the base gates. The briefing room was situated on base, within a small-fenced compound close to our hangar area. Also, inside the compound the Agency had a very large log periodic antenna tower, used for their radio traffic and to monitor our Birdwatcher equipment – unfortunately a typhoon blew the first one down before the footings were cured!
>
> The usual build-up for a Black Shield mission at the OL started with a pre-notice. With only two pilots and three aircraft to support the mission, both pilots were alerted to be ready for a 'GO'. Most of our missions were over North Vietnam, so we'd usually receive the alert about mid-morning the day before the planned sortie. We then usually conducted a pre-brief consisting of a weather forecast in the general area of interest; the intel guys would go over the expected areas of interest and the expected defences we were likely to face if we were detected and acted upon.
>
> Our ground crews would be busy readying the aircraft, the selected camera system and other recording devices. We always readied two aircraft for South-East Asia missions. Both Oxcart pilots attended the briefings; one would be designated primary, the other standby, in case primary had to abort. The Agency was completely focused in ensuring the flight was 'on time' no matter what. From memory, I think that the back-up aircraft was ready to launch should primary abort any time up to completion of the first tanker top-off.
>
> The day of the sortie, we'd attend the mission briefing; also, there was the Det CO and his assistant, the weather guy, an intel officer and the nav section guys, who briefed the route of flight and where our tanker support would be. We were then told a special little bit about where we could expect help if we were downed – I don't think any of us had too much faith in this part of the briefing. This entire final briefing took no more than an hour to complete, then we were off to the suit room and have a little physical examination so that the flight surgeons could verify that we were still alive! I was never

> told if at this point, they detected a slight increase in our blood pressure. Then the crew bus delivered us to the hangar; we'd get in and get on with it.

The next Black Shield mission (BSX-002) was alerted and scheduled for 6 June. However, it was subsequently cancelled due to adverse weather over North Vietnam. Weather cancellations proved to be a regular occurrence throughout operation Black Shield, highlighting the limitations of a purely photographic platform. Three days later, the mission was rescheduled and BSX-003 was flown on 10 June in Article 131 by Jack Weeks. It had been decided that mission sequence numbering would remain sequential and unchanged, even if an alerted mission was later cancelled.

Similar to BSX001, this mission also consisted of a single reconnaissance pass; the Oxcart entered North Vietnam over Haiphong at 04:10Z and exited nine minutes later. Weeks recovered the aircraft back at Kadena following a flight lasting four hours and 30 minutes. The prying lens of Article 131's Perkin-Elmer camera system again found no evidence concerning the deployment of SSMs, but the enormous quantity of high-resolution imagery was of great value to in-theatre commanders, tasked with planning and executing air strikes. This time 97 of the known 193 SA-2 sites in North Vietnam were photographed, 18 of which were occupied. Thirteen of the 27 COMIREX Priority I targets in North Vietnam were also covered.

Analysis of 131's ELINT and ECM systems again revealed no indication of the aircraft having been tracked or of a weapons reaction by either the Chinese or North Vietnamese, and neither system had recorded any Fan Song signals. DOD operational strike/jamming activity was heavy during the overflight period, with four EB-66C and one EB-66B aircraft conducting barrage and spot jamming which impacted upon numerous early warning and fire control radars.

Scheduled for 10 June, Black Shield's third foray over North Vietnam fell victim to the south-westerly monsoon season dominating Vietnam's weather from May to September. Designated BX6704, henceforth, the first two letters were changed to BX, followed by the next two digits indicating the year in which the mission was alerted, followed by another two sequential digits indicating the mission alert number.

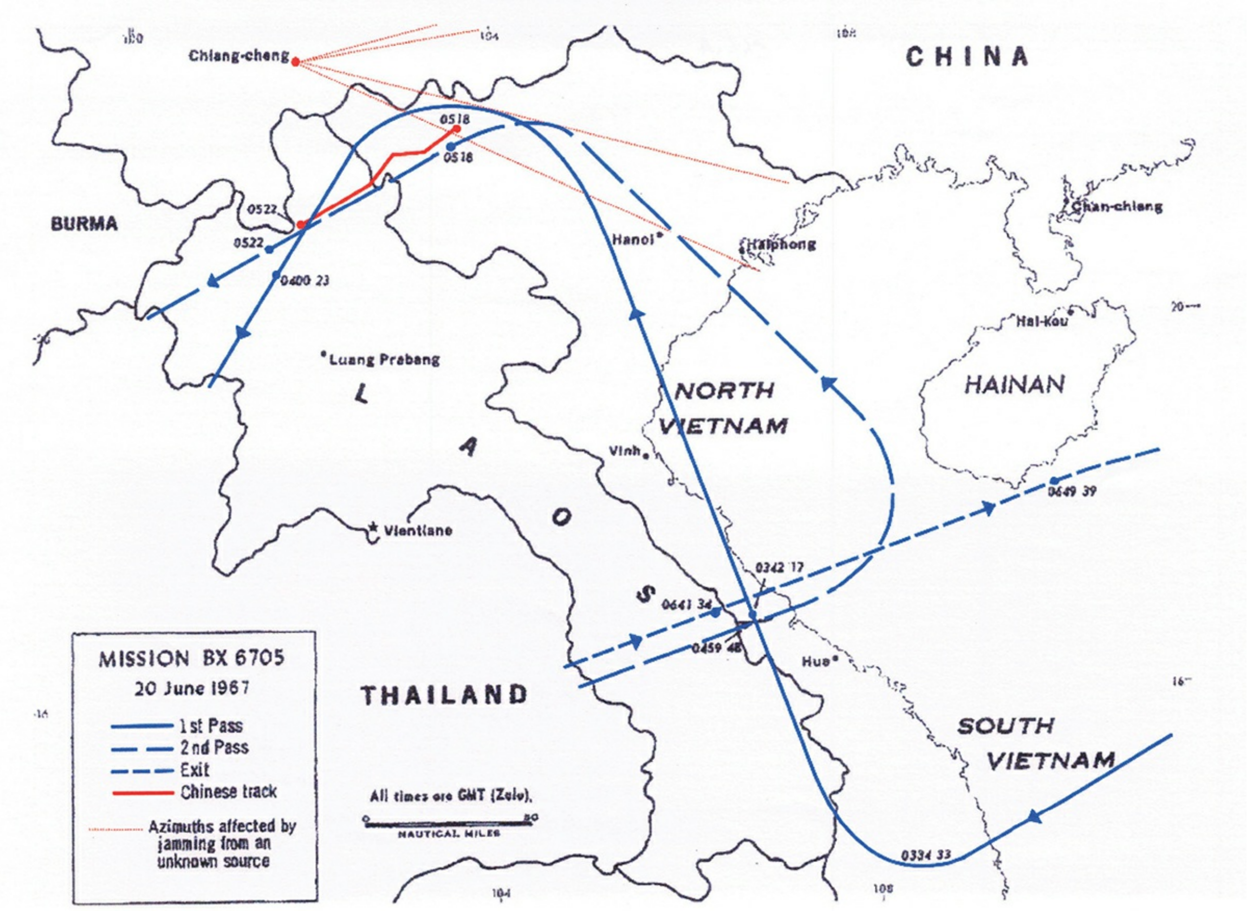
The classified nature of Black Shield and the Oxcart programme imposed many security restrictions on the pilots, one of which being that they were strictly forbidden to maintain a flight logbook. This is not perhaps surprising, but with the passage of time, dates and the chronology of events can become difficult to accurately recall. For example, the CIA's Office of Special Activities (OSA) official history categorically states that from between 31 May and 15 August 1967, 'there were no mission aborts'. However, during an interview with Jack Layton and the author in 2003, the Oxcart pilot vividly recalled what was to be his *first* operational mission:

> All had gone well until I hooked onto the KC-135Q's refuelling boom in the Deep Work AR track. The boom operator's first remark as the A-12's fuel tanks began to fill was, 'You don't want to go supersonic with this aircraft, sir.' I enquired why, as there were no cockpit indications that supported such a remark and the aircraft seemed to be handling well. 'I don't think you'll want to go fast, sir,' the boomer insisted, 'because the left side of your aircraft is missing.' After further consultation with the boom operator and other tanker crewmembers who came aft to view the unusual sight, I decided that prudence should dictate that I should abort my first mission, however reluctantly. As I turned back to Kadena, an F-102 interceptor was scrambled from Naha AB, Okinawa to serve as escort in the event of controllability problems. As the Delta Dagger drew alongside the crippled Oxcart, the F-102 pilot reported that the A-12 had lost practically all its left chine panels from nose to tail. In addition, large panels on the wing upper-surface (which also covered the top side of the wheel well) had disappeared, allowing the Dagger pilot to see right through part of the aircraft's left wing. As some of these panels had broken loose, at least one had impacted the top of the left fin, causing even more damage.
>
> As we descended below 20,000ft, we dipped into clouds and the A-12's cockpit fogged up so badly that I was unable to see my hand in front of my face, let alone read the flight instruments. I quickly called for the F-102 pilot to report the A-12's attitude, since I was becoming very concerned that the aircraft might depart its flight envelope by stalling or diving. I was very relieved that the A-12 had remained within normal flight parameters, and I managed to climb back out of the clouds. By turning the cockpit temperature control to full hot, I managed to eliminate the humidity that had caused the fogging, but the hotter-than-normal cockpit soon became extremely uncomfortable. Nevertheless, I was able to safely recover back at Kadena without further incident.

The OSA's official history states that Layton's debut Black Shield mission was BX6705, a double-looper, flown in Article 127 on 20 June 1967. The Oxcart was returned safely to Kadena after a flight time of five hours 30 minutes. For a third time, no SSM sites were found, however, the quality of 'the take' (categorized by Photo Interpreters as 'Excellent') captured 133 of the known 200 SA-2 sites, including three that were previously unidentified. Furthermore, it was possible to ascertain that 20 of them were occupied. Seventeen of the 27 COMIREX priority I targets in 'the north' were also imaged. However, success in the field of photographic intelligence (PHOTINT) was offset by intelligence gathered by US communications intelligence (COMINT).

It was during the course of BX6705 that COMINT secured proof that the

A-12 had been successfully tracked for the first time by a hostile radar facility (see map). The expansive US intelligence resource recorded the Chinese Communist radar facility at Chiang Cheng, reporting eight position points and the altitude of Article 127 as it flew abeam the facility during its second pass from 05:18Z to 05:22Z. It was at this point (at right-angles to the radar head) that the A-12 presented the largest (side-on) target. The initial and final detection ranges from radar head-to-vehicle, were 86 and 82nm respectively. Chiang Cheng was equipped with MOON FACE (a long-distance surveillance radar) and ROCK CAKE (an associated height-finder radar). The facility also reported jamming from an unknown source on its MOON FACE radar at 05:09Z. This jamming interfered with the effectiveness of the co-located ROCK CAKE radar at 05:13Z, on azimuth bearings from 105–115°, which bracketed the second leg of BX6705. It is probable that the ROCK CAKE radar operator was influenced by this jamming, and whilst actively searching these azimuths, this led inadvertently to the detection and subsequent tracking of Article 127. The reported altitudes accompanied each valid position report, which supported the tentative conclusion that the mission was tracked by Chiang Cheng's ROCK CAKE, height-finder radar.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0459 48
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16
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108
MISSION BX 6705
20 June 1967
1st Pass
2nd Pass
Exit
Chinese track
Azimuths affected by jamming from an unknown source
All times are GMT (Zulu).
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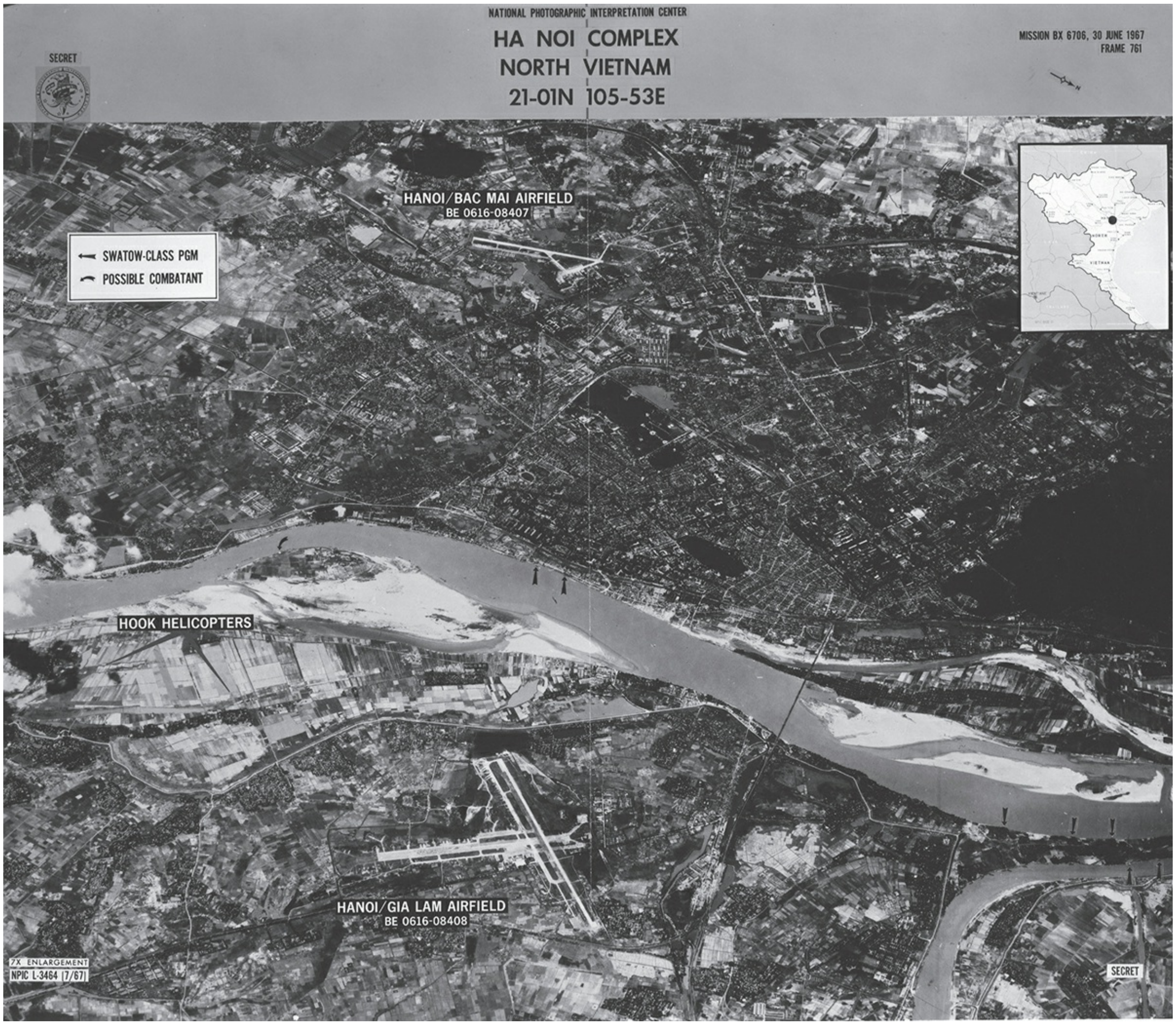
NAUTICAL MILES

It was during the course of BX6705 that US COMINT acquired evidence that an Oxcart had been tracked by hostile radar for the first time. (CIA, enhancement and colourization by Doug Fawkes)

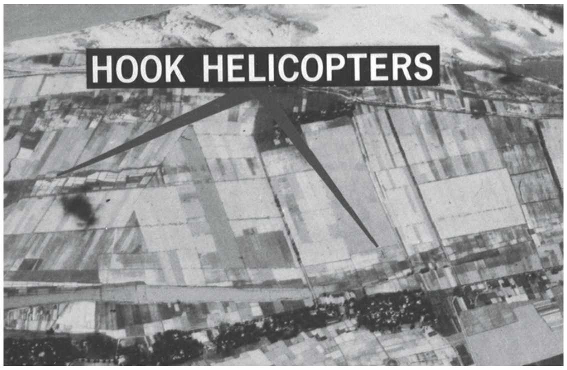

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER
HA NOI COMPLEX
NORTH VIETNAM
21-01N 105-53E
SECRET
MISSION BX 6706, 30 JUNE 1967
FRAME 761
N
HANOI/BAC MAI AIRFIELD
BE 0616-08407
SWATOW-CLASS PGM
POSSIBLE COMBATANT
HOOK HELICOPTERS
HANOI/GIA LAM AIRFIELD
BE 0616-08408
7X ENLARGEMENT
NPIC L-3464 (7/67)
SECRET

This frame has been analysed and annotated by the National Photographic Interpretation Centre (NPIC). It's part of frame 761, taken during BX6706, which was flown by Jack Weeks in Article 129 on 30 June 1967. (CIA via Robert Robarge)

Despite no known hostile weapons reactions to the mission being recorded on the SIP ELINT system, Layton exercised Big Blast (the on-board ECM jammer), for approximately 90 seconds, whilst the system was in manual jam override mode, as he was flying adjacent to Hainan Island during the return leg home.

Department of Defense (DOD) operational reporting could not account for the unknown jamming activity reported by Chiang Cheng, and Article 127 had not operated its jammers during this period. Unfortunately, the SIP ELINT system was inoperable during the tracking period, thus it was impossible to correlate the tracking data from the radar stations with the ELINT data. Fourteen hours after the mission, Chiang Cheng rebroadcast the track information to Kun-ming, the province's military capital. There was no indication of North Vietnamese tracking at this stage, or that tracking data secured by the Chicoms was passed to the North Vietnamese, however this occurrence was a pivotal moment in Black Shield operations.

Next up was BX6706, another double-looper flown on 30 June by Jack Weeks in Article 129. Again, mission photography provided no evidence of SSM equipment or associated facilities and of the known 205 SA-2 sites, 109 were photographed; this included three previously unidentified sites – 16 of which were occupied. The library of COMIREX targets also continued to grow and 21 of the 27 Priority I targets in North Vietnam were covered.



Taken from the earlier frame, this clearly demonstrates how fine the film grain was to be able to capture such a large area and then enlarge it continuously to extract relatively small details – in this case two Soviet-supplied Mil Mi-6 heavy transport helicopters. (CIA via Robert Robarge)

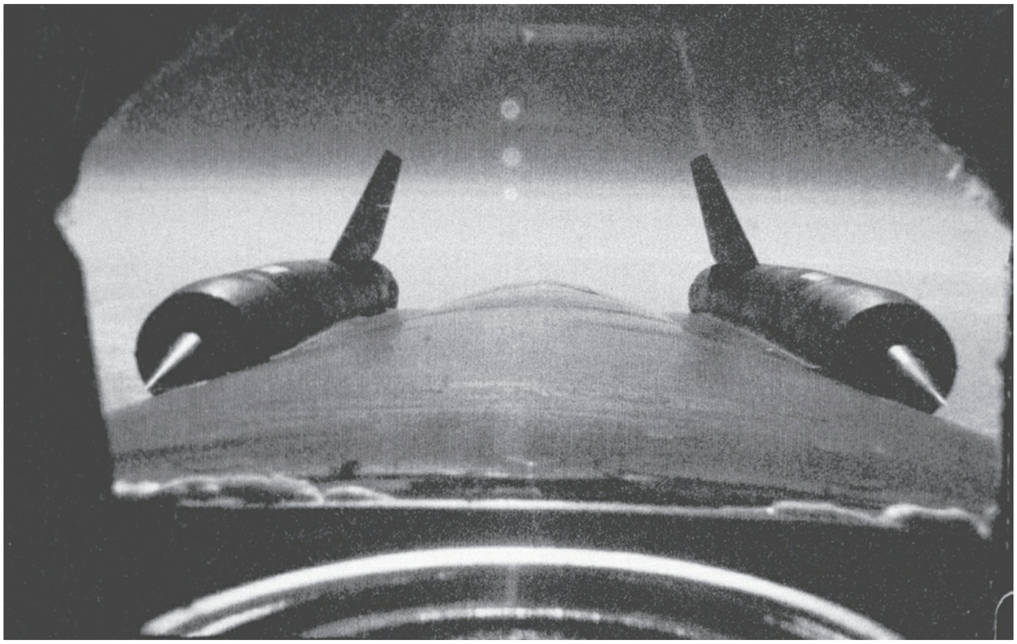
On this mission, the SIP ELINT package was replaced by a unit known as System 6S. Manufactured by Ramo Wooldridge (STL), as previously noted, it was a more advanced device, recording signals onto an analogue tape for later analysis. Although there were no indications of a hostile weapons reaction, six Fan Song signals were recorded. None of them, however, suggested that BX6706 had been tracked. As a result, no defensive systems on the aircraft were activated.

On this mission, Haikou, a Chinese air defence zone facility located on Hainan Island, reported track information about the sortie 13 hours 30 minutes after the mission had landed. The report covered an eight-minute period of the sortie from 04:05Z, and bracketed the flight as it passed to the south of Hainan

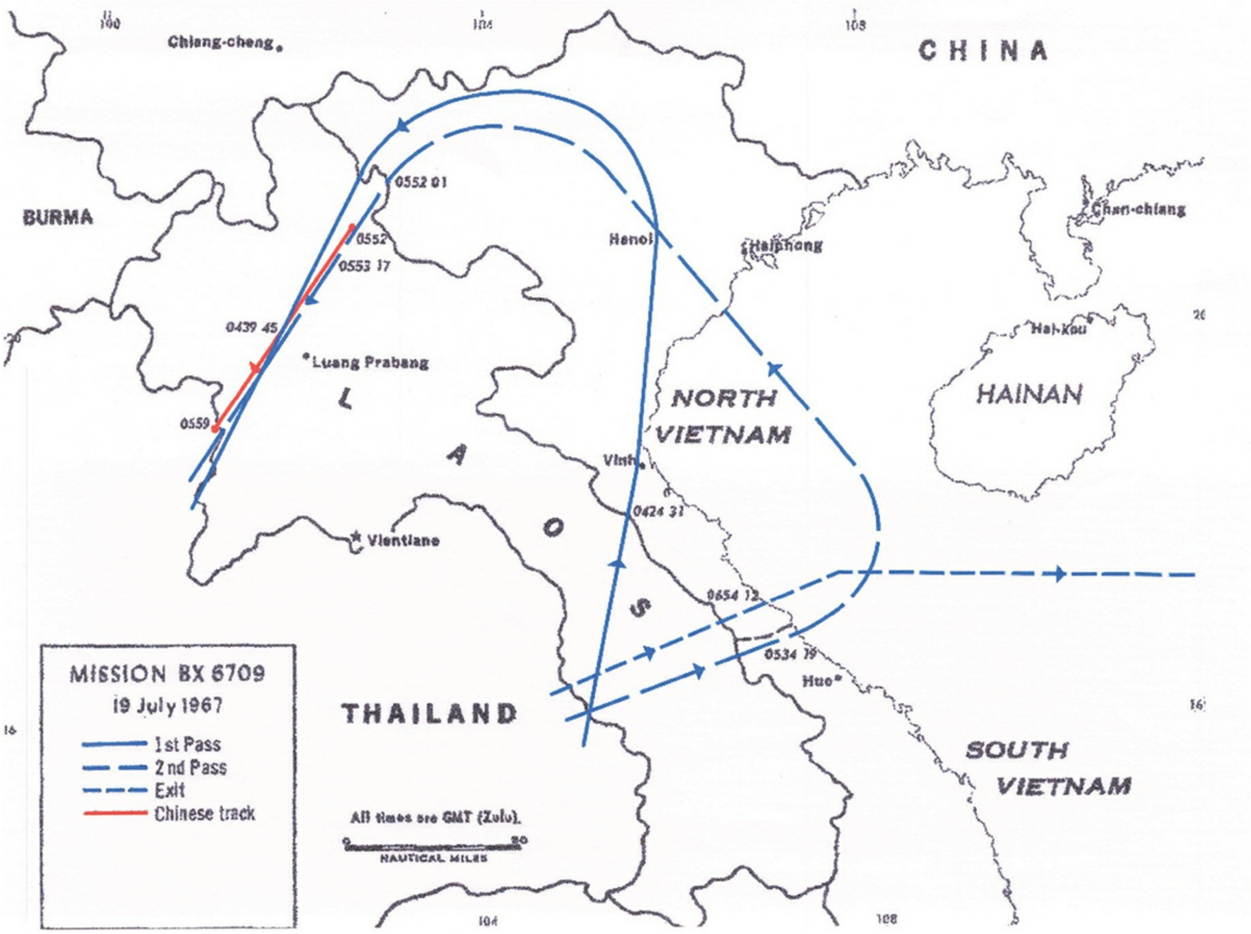
Island en route to North Vietnam. On this occasion no altitude information was included in the report. A US Navy EA-3B ELINT collection platform, in orbit during the overflight period, intercepted ROCK CAKE signals emanating from the Huang-Hu area of Hainan Island, and it is likely that this was the facility that had managed to briefly plot the Oxcart, as the time frame and duration of the intercepted signals compared favourably with those of the track period.

Between 05:30Z and 05:40Z, during Article 129's second pass, System 6 recorded a probable BIG MESH V-beam S-band radar, changing scan modes from circular to steady to circular. This may have been an indication of possible radar operator interest in the Oxcart or merely interest in the volume of space in which the mission aircraft happened to be. There was no indication of North Vietnamese tracking. Furthermore, there were no known DOD strike/jamming operations being conducted during the overflight period that could have been advantageous to the Oxcart in terms of providing additional 'electronic masking'.

Equipping Oxcart with System 6 proved to be an extremely effective method of 'hoovering up' a vast amount of signals data from enemy electronic emitters. The process of collecting, collating and analysing such signals is known as Electronic Support Measures (ESM), and Black Shield gathered a substantial amount of ESM data (see Appendix 2). This contributed to the NSA library of signals data, enabling them to establish the enemy's Electronic Order of Battle (EOB).



In an attempt to capture on film SA-2 launches fired at the three Black Shield Oxcarts, a rear-facing camera was installed. This view captures an A-12 at cruise speed and altitude. (CIA)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0654 12
0534 19
Hue
16
THAILAND
SOUTH VIETNAM
MISSION BX 6709
19 July 1967
1st Pass
2nd Pass
Exit
Chinese track
All times are GMT (Zulu).
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NAUTICAL MILES

During the course of BX 6709, the Chi Com radar facility at Chiang Cheng tracked the Oxcart for seven minutes. (CIA, enhancement and colourization by Doug Fawkes)

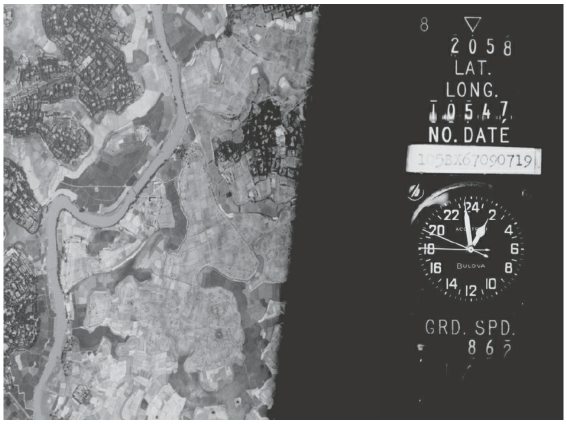
Operation Black Shield was dependent upon the successful operation of both the aircraft and its Type 1 camera package. This image, taken during mission BX6709 on 19 July 1967, shows the entire film area captured to the right of track, by one of the two tandem-mounted cameras. (National Archives via Lin Xu)

According to the CIA's OSA official history, a second Black Shield mission (BX6707) was also scheduled to be flown on 30 June 1967. However, the same document noted that it was cancelled due to the prevailing weather conditions over North Vietnam. It wasn't until 13 July that BX6708 was executed. This was a single pass, flown by Ken Collins in Article 127.

Yet again, mission photography failed to turn up any evidence of SSM equipment or facilities and 71 of the 214 known North Vietnamese SA-2 sites were photographed – including one previously unidentified site (five sites were occupied), and eight of the 27 COMIREX Priority I targets in North Vietnam were covered.

The mission failed to provoke a hostile weapons reaction; System 6 recorded four Fan Song signals, but they didn't appear to be tracking Article 127, and none of the aircraft's defensive systems were activated. The ELINT system also recorded two probable BIG MESH, V-beam, S-band, early warning radars that changed their scan modes from circular to manual and back to circular. Again, it was thought that these changes in the scan mode were more likely indicative of the operator's general interest in the airspace near the mission aircraft, since there were no COMINT intercepts to suggest that BX6707 had on this occasion been tracked by either Chinese or North Vietnamese radar facilities.

There was little or no DOD strike/jamming activity while the mission aircraft was over North Vietnam. Just one EB-66C, which was orbiting the area during the mission overflight period. Overall signal density was therefore characterized as light. It is interesting to note that on this occasion, hostile radars made no attempt to locate and track the A-12, because with no US strike or jamming activity in operation during the mission, it theoretically meant that Article 127 didn't benefit from additional 'radar masking' provided by these platforms. Additionally, with no US strike aircraft in the skies of North Vietnam, hostile radar facilities were unlikely to be attacked by US Wild Weasel aircraft toting anti-radiation missiles.



To aid photo interpreters, each frame was annotated at its outer-edge. The position of the A-12 during this exposure was Latitude 20 degrees 58 minutes North, 105 degrees 47 minutes East (near Hanoi). On the label below are three digits (relevance unknown), this is followed by the mission designation: BX6709. The time is recorded in GMT at 2:00am (local time 10:00am). GRD SPD is ground speed in knots (the first of four digits i.e. 1,000 is omitted, therefore the Oxcart is flying at 1,862 knots (2,234 mph). (National Archives via Lin Xu)

Six days later, on 19 July, Dennis Sullivan completed his first Black Shield mission in four hours 58 minutes. BX6709 (see map), was a double-pass sortie, entering North Vietnam over Vinh at 04:24Z and exiting via the DMZ at 06:54Z.

There were no indications of a hostile weapons reaction, and despite System 6 recording nine Fan Song radar signals, none appeared to be tracking Article 131, consequently none of its defensive systems were triggered. However, for a third time, an Oxcart was tracked. On this occasion it was the second time that the Chinese facility at Chiang Cheng managed to achieve the task, this time for seven minutes. However, the reported altitudes were extremely inaccurate, ranging from 8,000 to 11,000ft higher than Article 131's actual altitude. The type of radar generating this information was not identified, and there was no indication that the track information was passed to the North Vietnamese. DOD strike/jamming activity was moderately heavy during the overflight period, with seven ECM aircraft in operation (two EA3Bs, three EA1Fs, one EB-66C and an EB-66B).

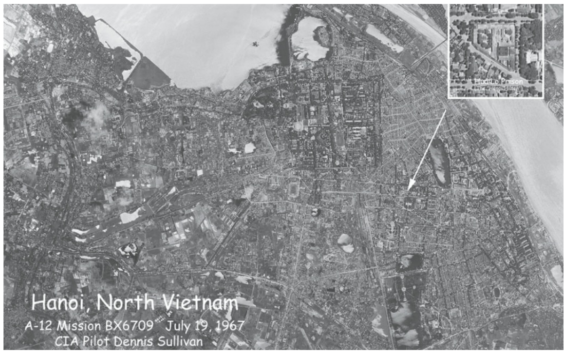
At the time of BX6709, US intelligence agencies were aware of 215 SA-2 sites in North Vietnam. Astute planning enabled Article 131's cameras to spot no fewer than 166 of them, including two previously unidentified sites. Of these, 12 were occupied, in addition, 12 of the 27 COMIREX Priority I targets in North Vietnam were also covered.

THE S-75M DVINA (NATO DESIGNATION SA-2 GUIDELINE)

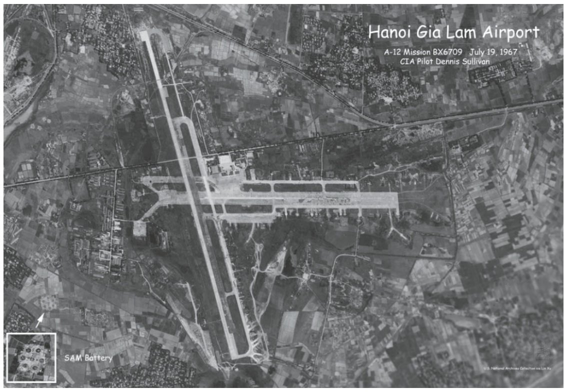
During the 50 days since the beginning of Black Shield operations, the North Vietnamese had constructed another 25 SA-2 sites (up from 190 to 215). It's therefore little wonder that US commanders planning air strikes in North Vietnam were becoming increasingly concerned and dependent upon frequent surveillance of these sites, utilizing Oxcart's high-resolution cameras to determine which were manned and which were empty when planning safe ingress and egress routes.

The standard North Vietnamese SA-2 unit was an air defence battalion (by 1968 US intelligence sources estimated that the North Vietnamese had between 35–40 SA-2 battalions). Each battalion consisted of six missiles on individual launchers and six additional missiles to reload. These were arranged in a circle, with command-and-control vans, electrical generators and an IFF interrogation system situated in the centre. The battalion was semi-mobile, and could be made ready to move to another site in less than four hours. Once relocated, it could be ready for action again within six hours. At the heart of the battalion was its Fan Song, track-while-scan radar. Three battalions made up an SA-2 regiment, which operated a surveillance radar to acquire targets for the firing battalions. The acquisition radar tended to be a 160MHz band Spoon Rest A (P-12) radar, which provided range, bearing, course and height information on the target.

The Fan Song B van carried two separate radars operating in the bands 2965–2990 and 3025– 3050MHz, each transmitting a peak power of 60kW. Each radar fed a different antenna, one vertical, the other horizontal and they were mounted on top of the cabin. One radar unit measured the target's azimuth, the other, separated by 60MHz, measured its elevation. An electronic scanning system swung the horizontal and vertical radar beams rapidly through 5° either side of the central axis of the trough antenna. The radars operated in unison, either in the search mode (a low Pulse Repetition Frequency (PRF) mode, of 800 pulses per second), or in the tracking mode (at a high PRF mode of about 1500 pulses per second).


Hoa Lo Prison
("The Hanoi Hilton")
Hanoi, North Vietnam
A-12 Mission BX6709 July 19, 1967
CIA Pilot Dennis Sullivan

The prying 'eyes' of BX6709's Type 1 camera captured the notorious North Vietnamese POW camp Hoa Lo, known by its captured US inmates as the 'Hanoi Hilton'. (National Archives via Lin Xu)


Hanoi Gia Lam Airport
A-12 Mission BX6709 July 19, 1967
CIA Pilot Dennis Sullivan
SAM Battery

In addition to updating the US intelligence communities' knowledge of Gia Lam, BX6709 also located an active SA-2 battery in the vicinity. (National Archives via Lin Xu)

The Fan Song van also transmitted uplink signals to each missile in flight to trigger its transponder beacon. The return downlink signals from the transponders were picked up by the Fan Song's two trough antennas. These signals were then passed to the firing computer, enabling it to track the movement of each missile. By measuring the relative position of each missile to its target, the computer generated the necessary guidance signals to provide a successful intercept solution. The guidance signals were radiated in the 700–850MHz band from the dish-shaped antenna mounted at one end of the horizontal trough antenna.

At the 'pointy-end' of the system was the Guideline missile. It was a 35-ft long and a two-stage weapon, consisting of a solid fuel booster and a liquid-fuel sustainer motor, which at launch weighed in at about 5,000lb. The command-guided missile, used by the North Vietnamese, carried a 280lb blast fragmentation warhead, detonated by a radar proximity fuse. With a maximum speed of over Mach 3, the missile could also be detonated by a command signal from the ground, or, if it failed to hit its target, it would self-detonate two seconds after the fuel for the sustainer motor ran out.

In a typical engagement scenario, the regiment's Spoon Rest acquisition radar initially picked up the prospective target. Once identified as hostile, the target's azimuth and range was passed to one of the firing battalions. Its Fan Song cabin and loaded missile launchers then swung on to the target's azimuth and the vertical trough antenna tilted to align itself on the target. The radars then began transmitting in search mode, in low PRF mode. The azimuth and elevation operators in the control van made adjustments to the antennas to centralize the target within the two scanning beams. Once this was achieved and the antennas were aligned, the system could be switched to the track-while-scan, high PRF mode. The system's analogue computer required about ten seconds of tracking to produce the required intercept solution, after which the battery was ready to launch.

The battalion commander could then choose to launch the SA-2 in either the predicted or lead intercept method, wherein the computer estimated the position of impact ahead of the target on the basis of the aircraft's speed, heading and altitude; after launch the missile or missiles flew a direct line for that point, making adjustments to its heading to correct for any evasive manoeuvres made by the target. Or, if the target was using Electronic Counter Measures (ECM) to deny the Fan Song radar accurate range data, the missile could be directed to fly along the continually moving direct line between the SAM site and the target, utilizing the best information available to determine when the target was in range for the SA-2 to be launched. This second method was less accurate, as the missile flew a curved path and its effective engagement range was less than when using the lead intercept method. By the end of 1967, 98 US aircraft had been shot down by SA-2s. Interestingly, although SAMs and MiGs certainly represented a danger to US strike aircraft, over 68 per cent of all US aircraft losses in Vietnam were due to anti-aircraft artillery (AAA).

AN OXCART, DRAGON AND DRONE

On 20 July 1967, weather conditions were again favourable over 'the North', enabling a back-to-back double-looper. The mission, BX6710, was flown by Ken Collins in Article 127 (see map). Additional company was planned in along the route that, it was hoped, might provoke an interesting response for those analysing the reactions of the Chicom and North Vietnamese air defence networks.

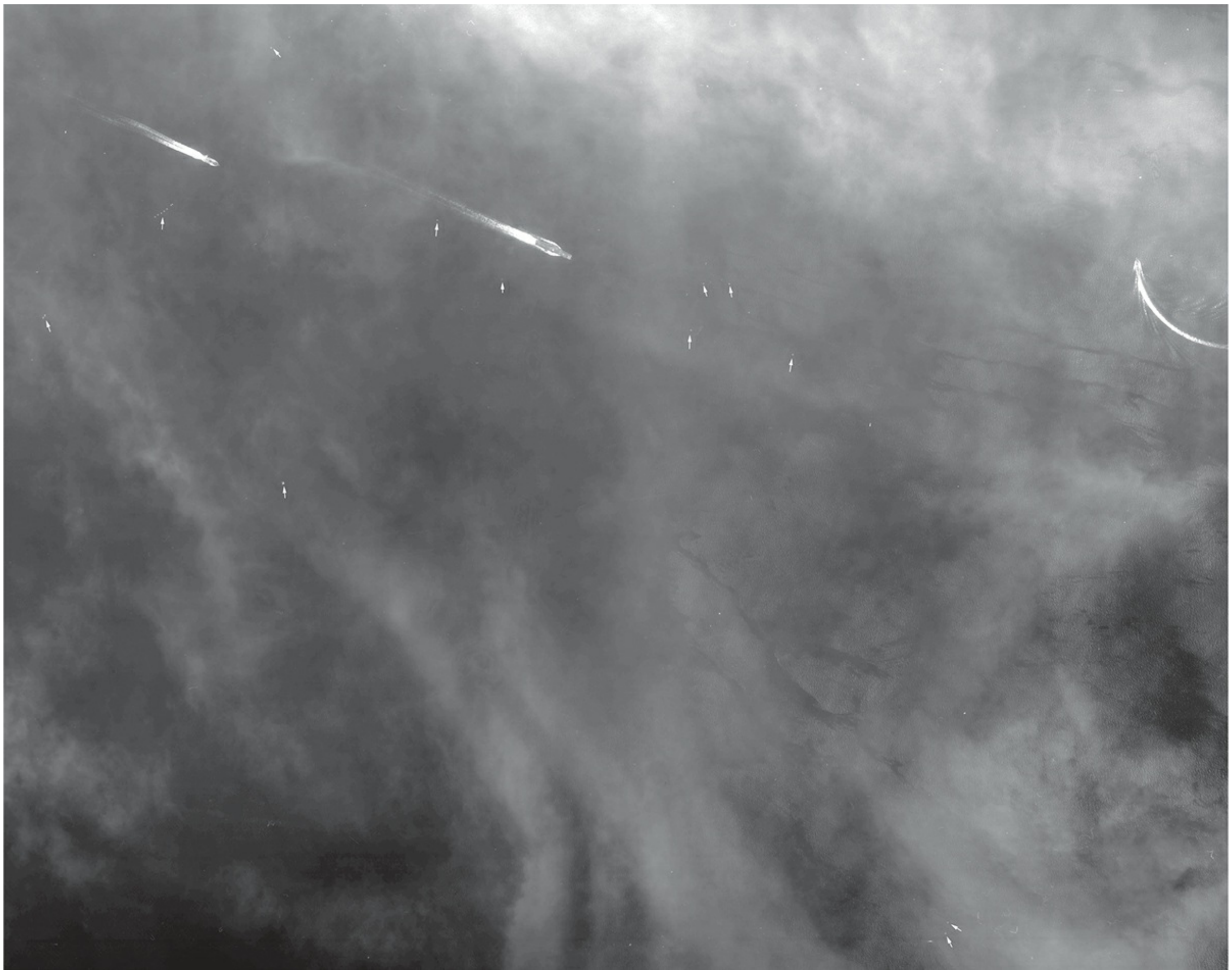
In mid-1960, under the cryptonym Project Tackle, the CIA, in partnership with the Republic of China (ROC), established a U-2 operation at Taoyuan airbase on Taiwan. Known as Detachment H, this composite formation comprised of both US and Chinese Air Force (CAF) personnel, the latter drawn from the 35th Squadron, 'The Black Cats'. Their primary mission was to conduct clandestine reconnaissance overflights of the People's Republic of China (PRC). Flown by extremely courageous CAF pilots, these missions were as sensitive as they were dangerous and by 1967 five of the Detachment's U-2s had been shot down by the Chicoms.

At 02:38Z (09:38L), on 20 July 1967, Capt Hung-Ti (Andy Feng) took off in U-2C tail number 3517, on a reconnaissance mission of southwest China, designated Church Door C237C. Shortly after take-off, the U-2 came within radar coverage of the Chicoms whilst over the South China Sea and from then onwards it was tracked continuously.

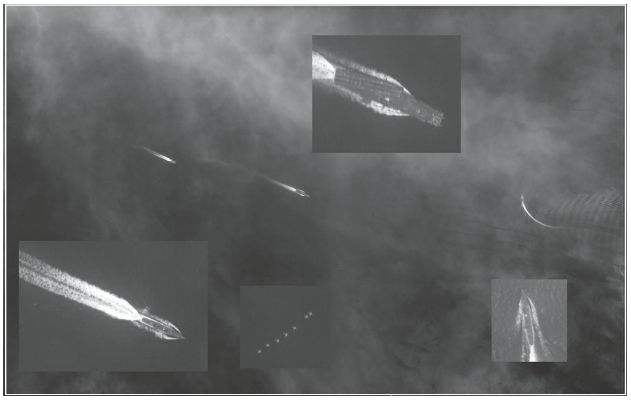
At 03:46Z, as the U-2 proceeded north, Collins in Article 127 headed west and the two flight paths crossed. The Chicom radar station at Huang-chu-shih broadcast the initial position of Article 127 one minute later. The radar station then continued to track and report the position of BX6710 until 03:51Z, after which other Chicom radar facilities continued the tracking process until 04:10Z. Having refuelled over Thailand, Collins climbed and accelerated #127 ready for his second pass over North Vietnam. This time a Ryan Model 147H Remotely Piloted Vehicle – RPV or drone (officially designated AQM-34N) – was planned to be in the area.

The drone had been deployed to Bien Hoa AB, South Vietnam, from the 100th Strategic Reconnaissance Wing, 350th Strategic Reconnaissance Squadron, based at Davis-Monthan AFB, Arizona. Designated Operating Location 20 (OL-20), the mission was codenamed Operation *Blue Springs* and the Detachment was tasked with conducting high-altitude reconnaissance overflights of southwest China and North Vietnam. To achieve this, the drone was air-launched, usually off the coast of North Vietnam, from a specially equipped DC-130A Hercules. Having completed its mission, which was controlled remotely by four dedicated RPV crewmembers aboard the DC-130, the drone was flown to a recovery area off the coast of South Vietnam. On arrival, a carefully choreographed sequence of events culminated in the RPV's engine being shut down, its parachute deployed and the craft being snagged by a CH-3 'Green Giant' helicopter of the 6593rd Test Squadron, equipped with a Mid-Air Retrieval System (MARS), as it slowly descended. The film package was then sent off for processing and analysing when the helicopter landed back at Da Nang AB, South Vietnam.

Like Church Door C237C, Blue Springs mission BSQ-190-V638 had been tracked continuously by hostile radars, and as the Article 127 coasted out over the DMZ, the two flight paths crossed at 05:07Z. The Chicom radar facility at Pei-li on Hainan Island reported BX6710's position and continued to track the Oxcart for 11 minutes. Significantly, COMINT monitored this information being passed via the Chicom's Kuang-chou DRV liaison link to the North Vietnamese – the first occasion that the transfer of such data had taken place. Then, at 05:11Z, just as Collins was about to coast in, the North Vietnamese air defence command and control centre at Hanoi Bac Mai airfield reported track plots for seven minutes – again highly significant, as this was the first instance that the North Vietnamese air defence network were aware of a Black Shield mission in real time. Finally, at 05:20Z as Collins cleared Hanoi and the autopilot initiated a shallow turn to the left, Article 127 was once again tracked by the Chicoms, this time for three minutes by Ping-uan-cheng. Throughout the course of BX6710, DoD strike/jamming operations were categorized as light. Despite being tracked, there was no hostile weapons reaction to Article 127, and System 6 did not record any Fan Song signals during the overflight.



BX6709 also captured part of the Seventh Fleet at Yankee Station – a position off the coast of Vietnam where US Navy aircraft carriers and support vessels loitered in open waters (arrows point to the position of US Navy aircraft). (National Archives via Lin Xu)



Further enlargement of the earlier image shows two escort vessels and USS *Oriskany* (CV-34, note the number on the carrier's foredeck), and seven A-4E Skyhawks awaiting clearance to land. (National Archives via Lin Xu)

The combined results of BX6709 and BX6710 provided near total coverage of the primary Surface-to-Surface Missile search area. Thus, in less than two months from the beginning of Black Shield operations, the National Photographic and Interpretation Centre (NPIC) were able to state with 80 per cent confidence that there were no SSMs based in North Vietnam – the Photo Interpreters, however, continued their diligent search of all subsequent Black Shield photography – just in case. Collin's mission photographed 80 of the known 219 SA-2 sites, including one previously unidentified site, of which five were found to be occupied – 19 of the 27 COMIREX Priority I targets in North Vietnam were also covered.

Further analysis of the back-to-back 'take' enabled NPIC to conduct a reassessment of North Vietnam's entire rail inventory. This indicated that the network was approximately three times larger than previously believed. It estimated North Vietnam to have between 2–3,000 freight cars and 100–120 locomotives. Of particular concern was photography of the P'ing-hsiang trans-shipment point in China, that showed approximately 100–130 field artillery pieces of unknown calibre on a nearby railroad siding. This alone was enough to equip two to three regiments, and they were almost certainly destined for use by North Vietnam in the south.

Ken Collins (personal call sign Dutch 21) completed his first Black Shield mission on 13 July 1967, and went on to complete a total of six operational sorties before the programme was terminated. (Lockheed Martin)

NORTH VIETNAM'S LEARNING CURVE

Oxcart's inability to gather PHOTINT when persistent cloud obscured the collection area must have been a source of frustration to US Theater Commanders, especially when it grounded all Black Shield missions for a month. As a consequence, missions BX 6711, 12, 13, 14 and 15, scheduled for 29 and 30 July, 13 August and twice on 14 August were all cancelled. It wasn't until BX6716, on 21 August 1967, that Mele Vojvodich got the show back on the road after completing a double-pass in Article 131 (see map). Although no hostile weapon reactions were directed at the Oxcart, onboard warning/defensive systems were activated for the first time during Vojvodich's first pass, indicating a missile launch and subsequent guidance via the following onboard systems: the ELINT package System 6 and the aircraft's ECM systems Blue Dog (the L-band guidance jammer), Big Blast (the S- and C-band noise jammer), plus in the cockpit the missile launch indicator lights.

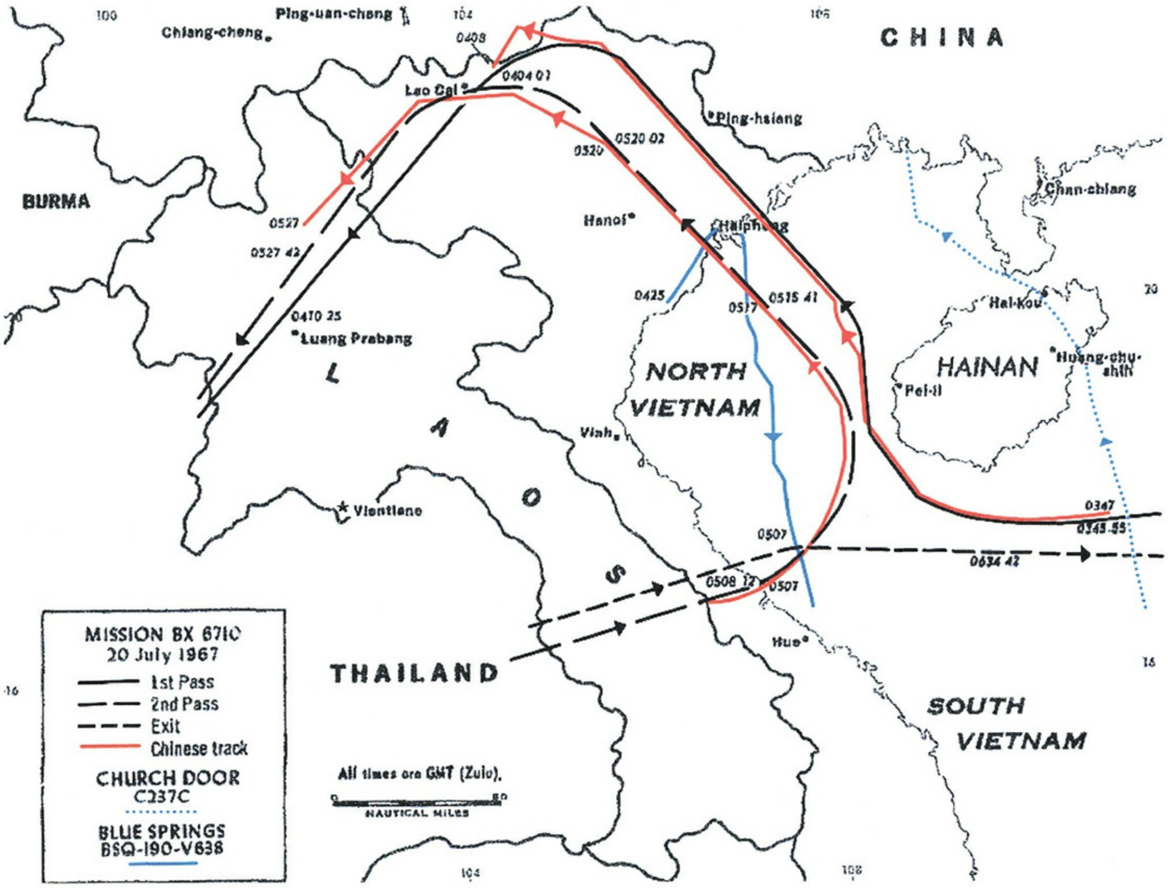
Once back on the deck, analysis of the System 6 tape indicated that none of the seven Fan Song signals collected appeared to be tracking the A-12. The L-band guidance signal intercepted by Blue Dog had come up before the Oxcart entered the Fan Song sector. Additionally, the Fan Song signal was in high PRF mode, and its duration of 20 seconds indicated that the missile was configured for flight to an altitude of 15,000 to 20,000ft. These parameters made the missile compatible to intercept aircraft at altitudes flown by most DOD strike aircraft operating over North Vietnam. Further analysis of the Blue Dog tapes indicated that the missile was not fired on a path that would intercept Article 131. Furthermore, COMINT gave no indication of Fan Song tracking or a missile launch relative to BX6716's position. It did, however, show that several missiles had been fired at numerous strike aircraft operating in the Kep and Lang Son areas at the time. The analysts therefore deduced that the Oxcart's ECM systems had been activated as a result of US strike activity and not directed at the A-12.

None of 131's onboard ECM systems were activated during the second pass, and although surveillance tracking was carried out by the Chicoms, there was no indication that the track information had been passed to the North Vietnamese. It was therefore deduced that tracking BX6716 was limited, probably due to the heavy strike and jamming operations being conducted by US forces during the overflight period. No fewer than five EB-66B, two EB-66C, and one EA-lF aircraft were actively engaged in jamming, so overall signal density was heavy.

Mission BX6716 photographed 156 COMIREX targets plus five additional bonus targets. Of these, 108 were SA-2 sites, including one previously unidentified site. Fourteen of the SA-2 sites photographed were occupied. This mission also provided good bomb damage assessment (BDA) photography, enabling analysts to ascertain damage to two turbine generators at Hanoi's electric power plant, and updated the status of the transportation network, having also photographed 18 bridges and 11 rail yards.

By August 1967, Operation *Rolling Thunder* had been rumbling through the skies of North Vietnam for nearly two and a half years. Underpinned by the White House's stratagem of only increasing the target list through the ridged adherence to a policy known as 'gradualism', the number of targets approved for air strikes had slowly increased, inevitably bringing with it an increased demand for yet more accurate, timely photographic reconnaissance.

With Black Shield sorties providing invaluable intelligence to theatre commanders and mission planners about the enemy's order of battle, as well as high-quality BDA assessment imagery, the challenge was to reduce the protracted timelines involved from film download to receipt of the processed imagery and production of the Initial Photographic Intelligence Report (IPIR). Therefore, to speed up the process, the 67th Reconnaissance Technical Squadron (Recce Tech) at Yokota AB, Japan, was provided with the necessary training and equipment to undertake the required work. Following an enormous amount of hard work and dedication by all those involved, on 18 August 1967 the 67th RTS was recertified as Overseas Processing and Interpretation Centre-Asia (OPIC-A). From thereon, theatre commanders had Black Shield imagery and an IPIR within 24 hours of a mission, and from mission BX6716 utilizing this invaluable resource became the standard operating procedure (SOP) throughout the remaining period of Black Shield operations.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Chan-chiang
Hanoi
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0527 42
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0515 41
Hai-kou
20
0410 25
Luang Prabang
NORTH VIETNAM
HAINAN
Huang-chu-shih
Pei-li
L A O S
Vinh
Vientiane
0347
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0508 12
0507
Hue
THAILAND
16
16
SOUTH VIETNAM
MISSION BX 6710
20 July 1967
1st Pass
2nd Pass
Exit
Chinese track
CHURCH DOOR
C237C
BLUE SPRINGS
BSQ-190-V638
All times are GMT (Zulu).
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NAUTICAL MILES
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BX6710, flown by Ken Collins in Article 129, saw two other high-flying, US intelligence-gathering assets positioned in the vicinity of the Oxcart during its mission. (CIA, enhancement and colourization by Doug

Fawkes)

Mission BX6717 was alerted and scheduled for 25 August, but it became another victim of the weather. However, BX6718, another double-looper, was flown in Article 127 by Jack Layton on 31 August 1967. The Black Shield vehicle entered North Vietnam on its first pass at 04:02Z and exited on its final pass (having air-refuelled in Thailand) at 06:45Z. But the mission was marred by a camera malfunction on the first pass and another fault that culminated in both a camera and inertial navigation system (INS) failure on the second pass. As a result, only 13 COMIREX targets were photographed – three of these being unoccupied SA-2 sites.

System 6 recorded eight Fan Song signals during the overflight, but none of these sites appeared to be tracking #127, consequently none of its onboard defensive systems were activated. The Chinese radar stations of Ho-lo-shih and Chiang-cheng managed to track the Oxcart; Ho-lo-shih for 12 minutes from 03:47Z to 03:59Z during its first pass, and Chiang-cheng for eight minutes during the second loop, from 05:39Z to 05:47Z. The Kuang-chou Sino-North Vietnamese liaison facility passed track information on BX6717 to the North Vietnamese from 03:56Z to 04:10Z; rebroadcasting the same information at 04:19Z. This was the second occasion that the Chicoms had passed vital tracking information to ‘the North’. Analysis of the tracking data indicated that there had been a delay of between nine to 11 minutes from initial detection by the Ho-lo-shih radar station and passage of the report to Hanoi. The time lag enabled Article 127 to pass over the SA-2 threat zones on its first pass before the North Vietnamese early warning system could react to the flight. This was something that needed to be streamlined considerably if ‘the North’ stood any chance of shooting down an A-12. Strike/jamming activity by US aircraft was very light during the overflight period, with just one EB-66C and one EB-66B operating in the vicinity for an hour from 04:02Z. Therefore, the Black Shield mission had received no benefit from additional radar masking.

The prevailing monsoon season caused the cancellation of three Black Shield missions BX6719, 20 and 21, scheduled to have been flown on 31 August, 5 and 10 September. It was therefore Jack Weeks who successfully completed BX6722, a double-looper in Article 129 on 15 September. However, most of the target area was masked by heavy cloud cover and the mission only managed to image 45 COMIREX targets, 17 of which were North Vietnamese SAM sites

– four of these were occupied.

Analysis of System 6 revealed the interception and recording of two Fan Song signals, but these were not in response to BX6722, and none of '129's ECM systems were activated. The mission was however tracked by the Chicoms for a total of 33 minutes. Pai-se tracked the Oxcart for one minute, and Chiang-cheng for three. Again, the tracking data was passed to the North Vietnamese, who in turn broadcast the information over the Hanoi hostile broadcast facility. Background jamming was light, with just one EB-66B and an EB-66C active over the Gulf of Tonkin.

Two-looper Mission BX6723 was flown by Ken Collins in Article 131, on 17 September 1967. Taking four hours to complete, it targeted Hanoi, Haiphong and the Chinese border. For a change, the weather was good, with only about 10 per cent of the target area masked by cloud. This proved extremely helpful, as docked in Haiphong harbour and of particular interest to the PIs was the Soviet freighter *Partizanskaya Iskra*. Intelligence sources believed that the ship was carrying an alleged cargo of SS-N-2 (Styx), anti-ship cruise missiles. In a further stroke of luck, all five of the freighter's hatches were open, enabling the PIs to conduct a thorough search of the ship's holds and the surrounding port area. Despite this, the search failed to detect any SS-N-2 crates or associated equipment. Mission photography provided good BDA of the port areas and land transportation network. In addition, over 200 COMIRIEX targets were photographed, of which 150 were North Vietnamese SA-2 sites, including four new sites. Just 19 of the total number of sites imaged were occupied, demonstrating how difficult it was for US planners to accurately assess where the missiles were actually located, when 'the North' had so many sites into which they could deploy their SAMs.

There was no indication of a hostile weapons reaction; however, North Vietnamese SAM communications did reveal a hostile intent, when at 03:52Z a SAM site was instructed to go to a 'condition one' by the regimental controller ('Condition one' in Soviet/Vietnamese terminology defined the highest state of readiness of a SAM site). COMINT indicated that the site tracked the Oxcart with its acquisition radar, but was unsuccessful with its Fan Song guidance radar. Reference to Article 131's 'very fast' speed and altitude of 82,000ft were noted by the North Vietnamese SAM communication. COMINT also indicated that a second site was unsuccessful in its attempt to pick up the Oxcart with its guidance or acquisition radars. From a North Vietnamese perspective, this mission was noteworthy as it was the first occasion that a Black Shield aircraft was mentioned by their SAM air defence system.

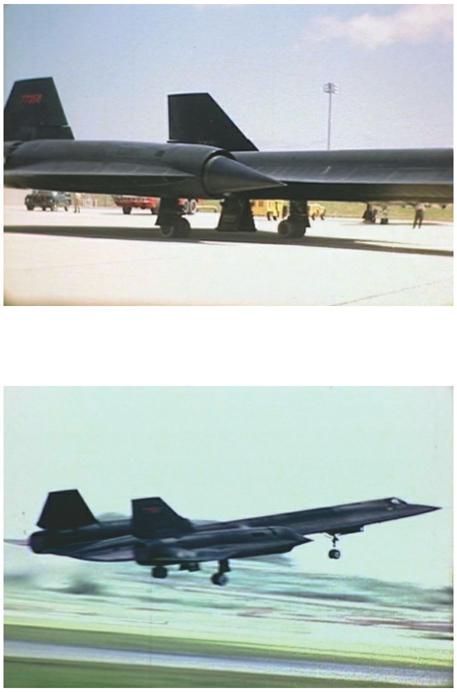
System 6 recorded five Fan Song signals during the overflight, none of which appeared to be emanating from sites tracking Article 131, so no onboard defensive systems were activated. Air surveillance tracking was carried out by elements of the Chinese air defence system and passed to the North Vietnamese. Three Chinese radar stations were involved in this exercise, Chiang-cheng, Hsin-hsing and Tung-kuan-shao. Throughout the mission, there was no indication of any DOD strike/jamming activity. Significantly, this was the first Black Shield mission with complete, unbroken air surveillance tracking of the vehicle while over North Vietnam, demonstrating an effective and ever-increasing level of cooperation between the Chicoms and North Vietnamese.

SECRET
0194
BX6710 20 JUL 67
SECRET

It is possible that the proximity of the Chinese island of Hainan, close to North Vietnam, generated an intelligence requirement to gather PHOTINT. The clarity and angle of this image, taken during BX6710, suggests that the mission flew close to the island (data displayed on the frame gives a position of Latitude 19 degrees 18 minutes North, Longitude 108 degrees 25 minutes East). (National Archives via Lin Xu)

BX6724 was scheduled for 1 October, but the weather intervened and the mission was scrubbed. Three days later, however, Ken Collins completed the planned double-pass recon take of BX6725 in Article 127. This mission proved to be yet another significant milestone for 'the North' in their continued quest to develop effective SAM tactics to intercept the tri-sonic intruders. Two Fan Song signals were intercepted on the first pass. These activated the onboard ECM systems, but there was no indication of a missile launch, and no threat signals were intercepted during the second pass.

The 'take' covered over 40 per cent of the country, including the Hanoi, Haiphong and Thai Nguyen areas, plus the key Pingxiang and Dong Dang trans-shipment points on the Chinese/North Vietnamese border. Analyzing the photography, PIs discovered the presence of armoured vehicles on flatcars at Pingxiang, China. This represented a significant escalation in hardware exports, as previous shipments had been limited to field artillery and AA guns. A total of 18 COMIREX and 16 bonus targets had been imaged, of these 154 were SA-2 sites, which included 18 that were occupied.



A sequence of frame grabs taken of a Black Shield A-12 taxiing from its hanger and getting airborne at Kadena AB. Note the bogus serial applied in red on the tail, '77358'. (CIA via Toni Hiley)

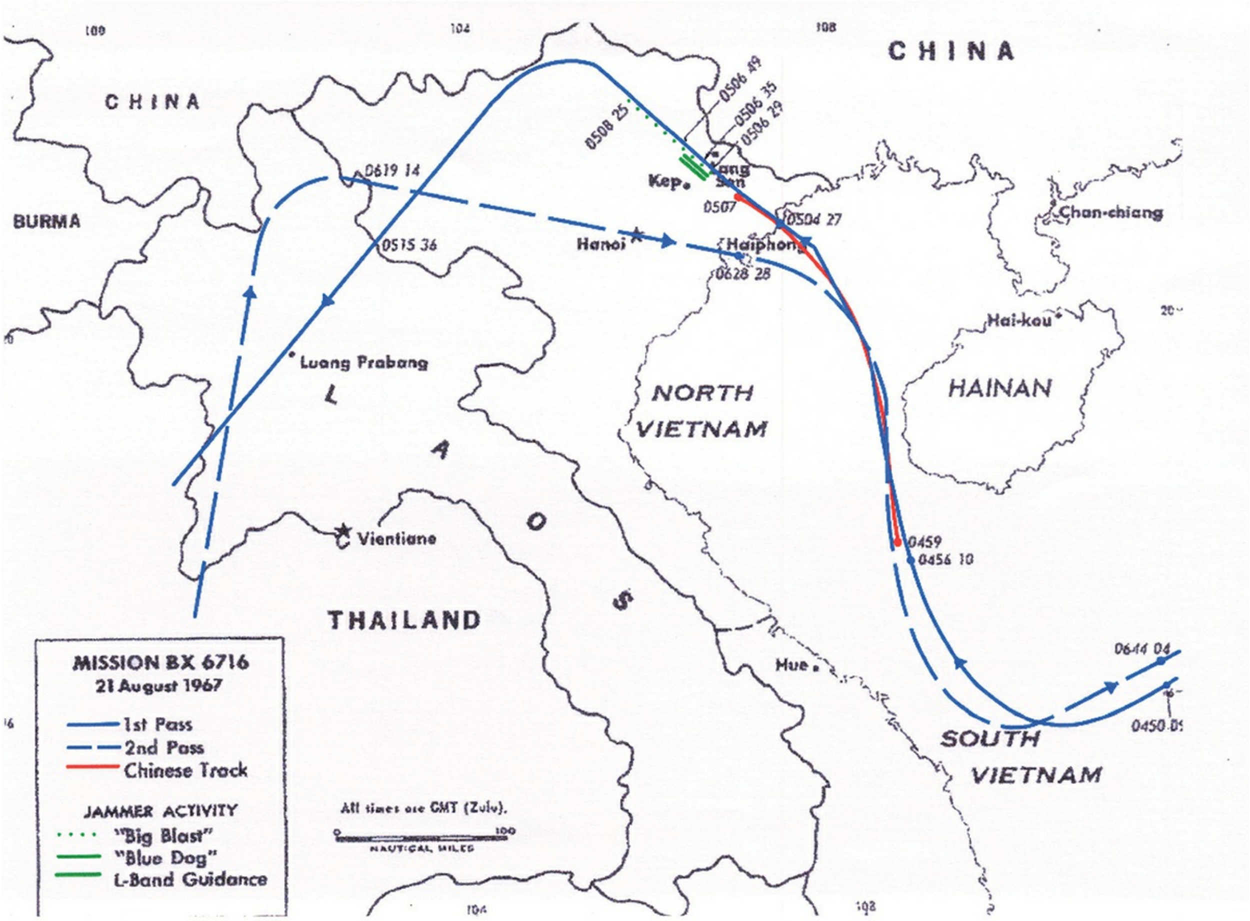
At 03:35Z the Kuang-chou District broadcast the initial detection of BX6725, and upon receipt of this information, the Bae Mai hostile broadcast facility in Hanoi began retransmitting the track of Article 127. Three minutes later, at 03:38Z, a SAM battalion (most probably VN 64) alerted the senior regimental SAM controller to the approach of a high-altitude, 'very fast' target at a range of 108nm. This detection range was compatible with its Spoon Rest A radar, which was collocated with the battalion at site VN 64. As Article 127 coasted in to North Vietnam at 03:42Z, it intercepted Fan Song signals, which in turn activated the Mad Moth jammer.

Two SAM battalions located in the Hanoi area at sites VN 64 and VN 142 were now actively tracking #127. A message intercepted two days later on 6 October recorded the SAM controller at site VN 142 conversing with his regimental controller. The former stated, 'Several units picked up the target, the SR-71 [*sic*]…We couldn't pick it up because it was too fast…Those that picked it up lost it within 3 minutes,' (these statements coincide with Ken Collin's mission of 4 October). In the cockpit, Collins received Pin Peg warnings via the DF lights that also indicated threat activity emanating from the Hanoi, Phuc

Yen areas. A combined analysis of COMINT, ELINT and photography subsequently suggested that site VN 64 was attempting a missile launch. Its initial Fan Song was in low PRF providing a detection range of 57nm, before it was switched into and then out of, high PRF at 32 and 30nm. This practice was compatible with known SAM operations at the time. Although the SAM battalion at VN 64 tracked '127 in the high-PRF mode for approximately 60 seconds, it didn't launch a missile. This was because the offset range between the site and the Oxcart was 24.7nm – a distance insufficient for the missile to have successfully intercepted its target.

Tracking of Article 127 was reported by the Chicoms to the North Vietnamese air defence system for 30 minutes from 03:33Z and again from 05:01Z to 06:01Z. To ensure that the Oxcart plot messages received utmost priority through the communication network, the Chinese air surveillance authorities bestowed upon Oxcart a special 'trinome'. This greatly speeded up Chinese position plot reporting times by between 4 to 6 minutes, shrinking them down now to the order of between just 1 to 3 minutes, giving the Vietnamese SA-2 network more time to prepare for an engagement. On this occasion, however, there was no indication of tracking by North Vietnamese air surveillance facilities. The two Chinese radar stations at Hsi-chi and Chiang-cheng were again noted reporting tracking '127. During the first pass, seven strike/reconnaissance aircraft were active during the SAM activity, while 57 strike and four ECM Iron Hand aircraft were active during the tracked but uneventful second pass. The North Vietnamese air defence system was slowly, but relentlessly, putting the Oxcart intercept puzzle together.

BX6726, scheduled for 4 October, was cancelled for unspecified operational reasons, but two days later, Frank Murray flew his inaugural Black Shield mission – an event that turned out to be quite a handful. Designated BX6727 and scheduled as a double-pass, the mission was flown in Article 131. Significantly at 01 :28Z – 51 minutes prior to initial detection of the aircraft by Chinese radar facilities and 13 minutes before penetrating North Vietnamese airspace – the SAM battalion located at VN 142 was informed, 'From 02:10Z on, there will be an SR-71 [*sic*]…Be ready to battle.' Such advanced warning provided the North Vietnamese with ample time to prepare their defences and four SAM battalions were immediately put on alert. However, as the mission flight path was well north of two of the sites, they were unable to participate in any form of launch activity. The two SA- 2 battalions situated at sites 142 and 148 were offset 60 and 6 nautical miles respectively from Murray's track (the former too close, the latter too far to implement a successful intercept). In total, System 6 recorded seven Fan Song signals during the overflight, but none appeared to be tracking '131, consequently none of its ECM systems were activated.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Lang Son
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0619 14
0515 36
Hanoi
Haiphong
0628 28
Chan-chiang
Hai-kou
20
HAINAN
NORTH VIETNAM
Luang Prabang
L A O S
Vientiane
THAILAND
0459
0456 10
Hue
0644 04
0450 05
SOUTH VIETNAM
MISSION BX 6716
21 August 1967
1st Pass
2nd Pass
Chinese Track
JAMMER ACTIVITY
"Big Blast"
"Blue Dog"
L-Band Guidance
All times are GMT (Zulu).
100
NAUTICAL MILES
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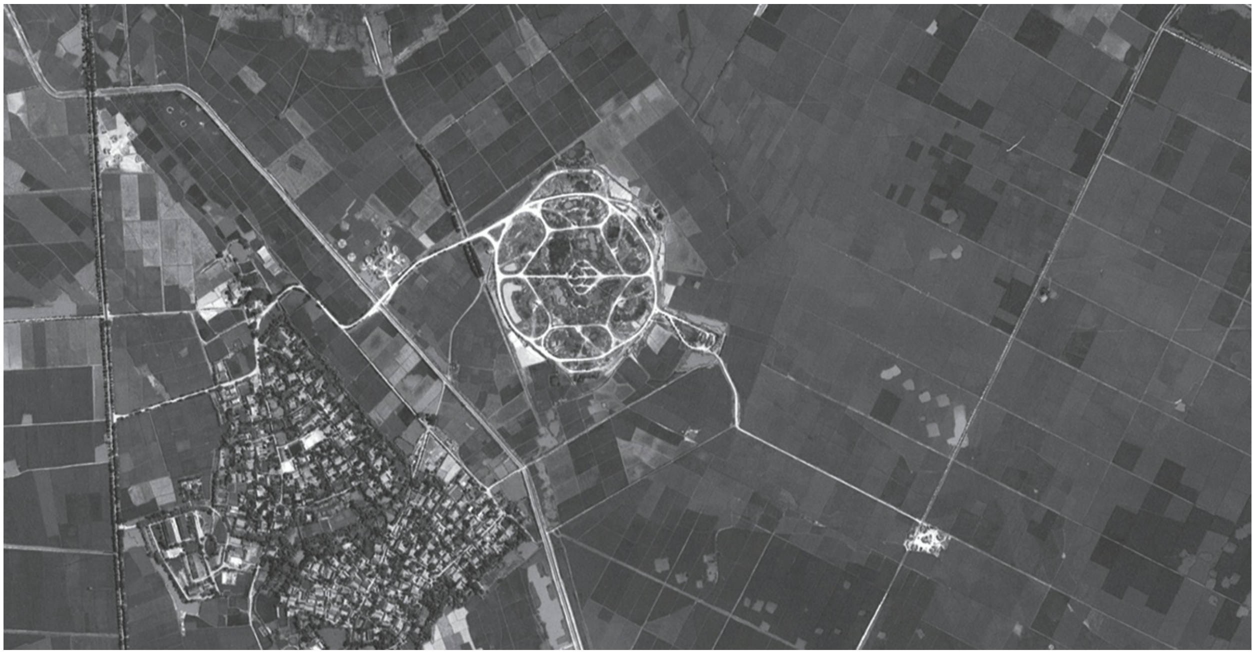
During the course of BX6716 the Oxcart's Defensive Systems (DEF) were activated for the first time. (CIA, enhancement and colourization by Doug Fawkes)

Both Chinese and North Vietnamese air defence facilities were noted reporting the tracking of 131, with Bai Thuong being the first North Vietnamese radar station to broadcast a tracking report of a Black Shield mission. The radar station detected 131 at 02:37Z at a ground range of 156nm and they continued to successfully track it out to a range of 172nm. Three other radar stations, San-pao-chi, Chiang-cheng in China and Dien Bien Phu in

North Vietnam, reported initial and final detection tracking-ranges of 56–248nm, 142–29nm, and 180–64nm respectively. All reported tracks and altitudes were compatible with those of 131. During the ten minutes over denied territory, just one EB-66C and one EB-66B jamming platform were active as strike activity was very light.

With all this enemy activity going on, it was a mechanical issue that caused Murray the most disquiet, as he recalls,

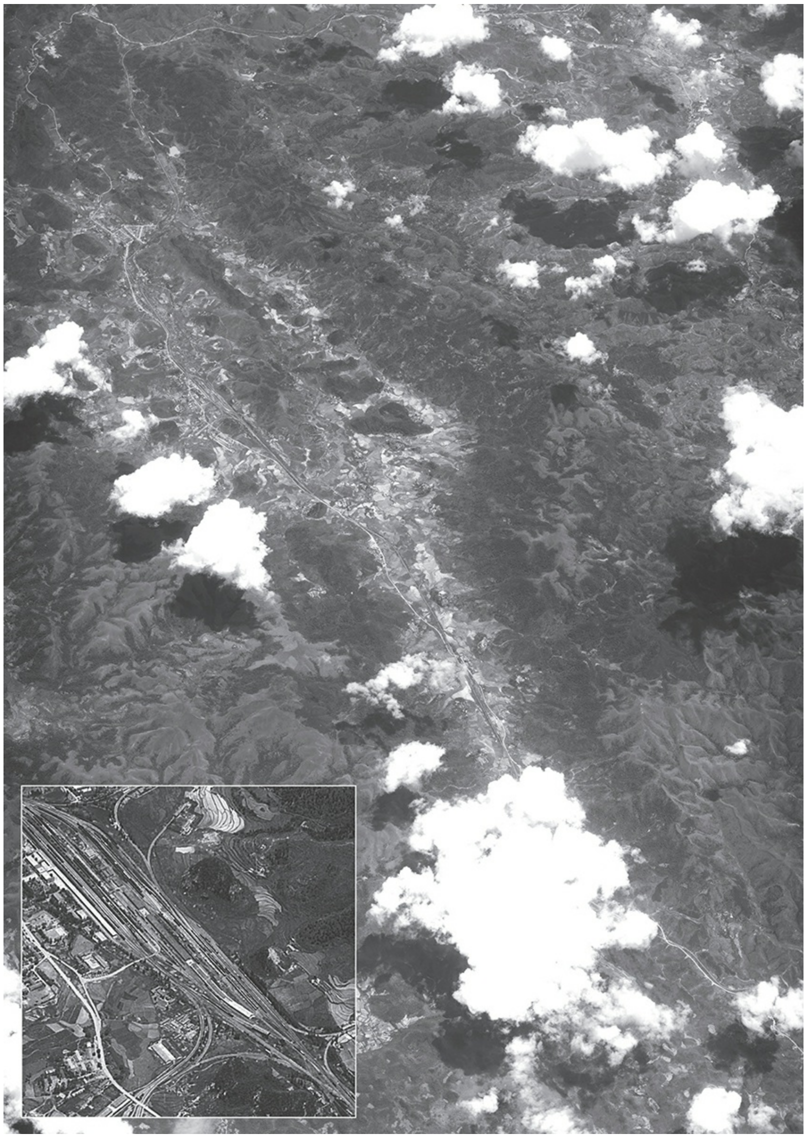
> I commenced my first photo run at an altitude above 80,000ft, on a track deep into North Vietnam with all systems functioning well. But as I was about to turn off my cameras before heading south, toward Scope Pearl, the air refuelling track in Thailand, my left engine started vibrating, followed shortly thereafter by a left inlet unstart.
>
> I had my hands full for a while. In fact, I ended up having to shut the engine down. I increased power on the good engine and flew it at maximum temperature for about an hour before I hooked up with the tanker. Because of the shutdown engine, I decided to divert into Takhli and the tanker crew relayed massages back to Kadena that I was diverting. Because I kept my radio calls to a minimum for security reasons, I didn't identify myself to the Takhli air traffic controllers until I was on final approach for landing.
>
> I landed after just two hours 20 minutes without incident, but inadvertently screwed up a complete F-105 strike mission launch when I jettisoned the big brake 'chute on the main runway. I turned off the runway and sat there with the engine running and asked that the base commander come out to the aircraft as there were certain things I had to tell him. My presence was causing a pandemonium of curiosity. There was this most unusual black aircraft with no markings, the like of which nobody on that base had ever seen before, which had dropped in completely unannounced, disrupting a major operation and its pilot insisting on the base commander coming out to see him! While this was going on, guys on base with cameras were clicking away like mad. Eventually they sent out the Thai base commander, which was no good because I wanted the US base commander. He eventually arrived and (despite all my disruptions to his war operations) was extremely helpful.



Mission photography captured 108 SAM sites during Vojvodich's sortie in Article 131 on 21 August. An SA-2 site is imaged with four launchers occupied with missiles. (National Archives via Lin Xu)

After Frank's aircraft had been safely tucked away in an Agency U-2 facility on the base, the Air Force security police had a field day confiscating the opportunists' film. An inspection of the left engine revealed that most of its moving parts had been 'shucked like corn from the cob' and were lying in the tailpipe and afterburner. A recovery crew flew in a spare engine, but Article 131 had also sustained notable damage to the nacelle and some of its nearby electrical wiring. It was decided that the jet would have to be flown back to Kadena 'low and slow' on 9 October. Frank explained: 'I got airborne and headed off south over the Gulf of Thailand, where I picked up an F-105 escort that led me out over South Vietnam. An escort of F-4s then covered me and my tanker, before breaking off to return to their base. We then made our way via the Philippines, where I picked up another tanker, which led me back to Kadena.'

While Frank was dealing with the inflight emergency over North Vietnam, his attention had been diverted away from switching off the cameras to the more pressing priority of controlling his aircraft. Overall photography was good, although scattered clouds covered approximately 40 per cent of the target area. Thirty-six COMIREX targets were photographed – nine of which were SA-2 sites, but occupancy level could not be determined. As he turned south, his camera had taken a series of oblique shots into China. Close analysis of those photos revealed eight tarpaulin-covered objects among a mass of other material along the large main rail link between Hanoi and Nanking. Further photo interpretation ascertained that the 'tarps' were flung over rail flatcars in an attempt to hide 152mm self-propelled heavy artillery pieces. A great mass of other war materiel in the rail yards had been assembled for onward movement to North Vietnam during the oncoming winter season, when low clouds and poor visibility would hamper US bombing efforts to halt south-bound supply lines. A timely and highly valuable piece of strategic intelligence, gained on the back of Frank's troubled sortie, had delivered a unique opportunity to track the further movement of those guns and supplies, which were obviously intended for use in future offensive actions. An investigation into the source of the message forewarning of the Oxcart's arrival over North Vietnam proved negative.



The northerly route of BX6716's first pass took it close to the North Vietnamese/Chinese border. This enabled photo interpreters to study the important Pingxiang rail trans-shipment yard, where they discovered rolling stock carrying trucks, mortars and anti-aircraft artillery bound for North Vietnam. (National Archives via Lin Xu)

Article 131 was busy again when, on 15 October, Ken Collins flew a double-looper. BX6728 was over North Vietnam for 12 minutes on its first pass and 11 on the second.

Yet again 'authoritative Chinese echelons' warned Chinese radar stations that 'Today there will be a high-altitude, high-speed situation; complete preparations.' The warning broadcasts lasted for 46 minutes and began two hours 47 minutes before #131 even coasted in over North Vietnam. This points to a radio report being filed to the Chicom defence network as a result of either a visual sighting of 131's departure from Kadena, or from a radio intercept captured whilst the aircraft was air refuelling after take-off in the Deep Scope air-refuelling track over the South China Sea (it was probably the same information source that broadcast similar information about the previous mission on 4 October).

Chinese and North Vietnamese air defence facilities were noted passing tracking data on 131 for ten minutes, from 03:23Z. The latter monitored the Kun-ming sector which broadcast and rebroadcast the aircraft's track over the Hanoi Bac Mai facility. System 6 recorded one Fan Song signal during the overflight period. The signal did not appear to be emanating from a site tracking the mission vehicle, therefore the ECM system was not activated.

Due to extensive cloud cover, photographic coverage was severely limited to just 10 per cent of the targeted area. Nineteen COMIREX targets, seven of which were SA-2 sites, were imaged, which included one new site with its distinctive 'star of David' layout, but none of those photographed were occupied.

Following this mission, and as a result of the COMINT intercepts, a more secure communications posture was employed in the refuelling area, and this resulted in an end to the forewarning broadcasts. During the mission period, there were little or no strike/jamming operations.

On 18 October Murray flew his first double-pass mission. Entering denied airspace in Article 129, at 03:46Z, mission BX6729 spent a total of 16 minutes over North Vietnam.

System 6 recorded one Fan Song signal which was not tracking the aircraft and none of 129's onboard defensive systems were activated. Chinese and North Vietnamese air defense facilities continued reporting tracking the aircraft on four occasions for a total of one hour and 18 minutes and the North Vietnamese radar station at Vinh was noted rebroadcasting the track of 129 from 04:00Z to 04:25Z.

Cloud-free photography was obtained over about 50 per cent of the country, including the Hanoi and Haiphong areas. Mission photography revealed construction activity by Chinese engineers of Yen Bai airfield and 193 COMIREX targets were imaged, of which 153 were SA-2 sites, 16 of them were occupied, including one newly identified site. In addition, dummy SA-2 missiles were noted occupying one of the sites.

During Murray's first pass, no strike/jamming aircraft were noted in operation and during his second pass, just two EB-66s were conducting active jamming, therefore the overall signal density was characterized as light, signifying that Article 129 did not benefit from any airborne 'radar masking'.

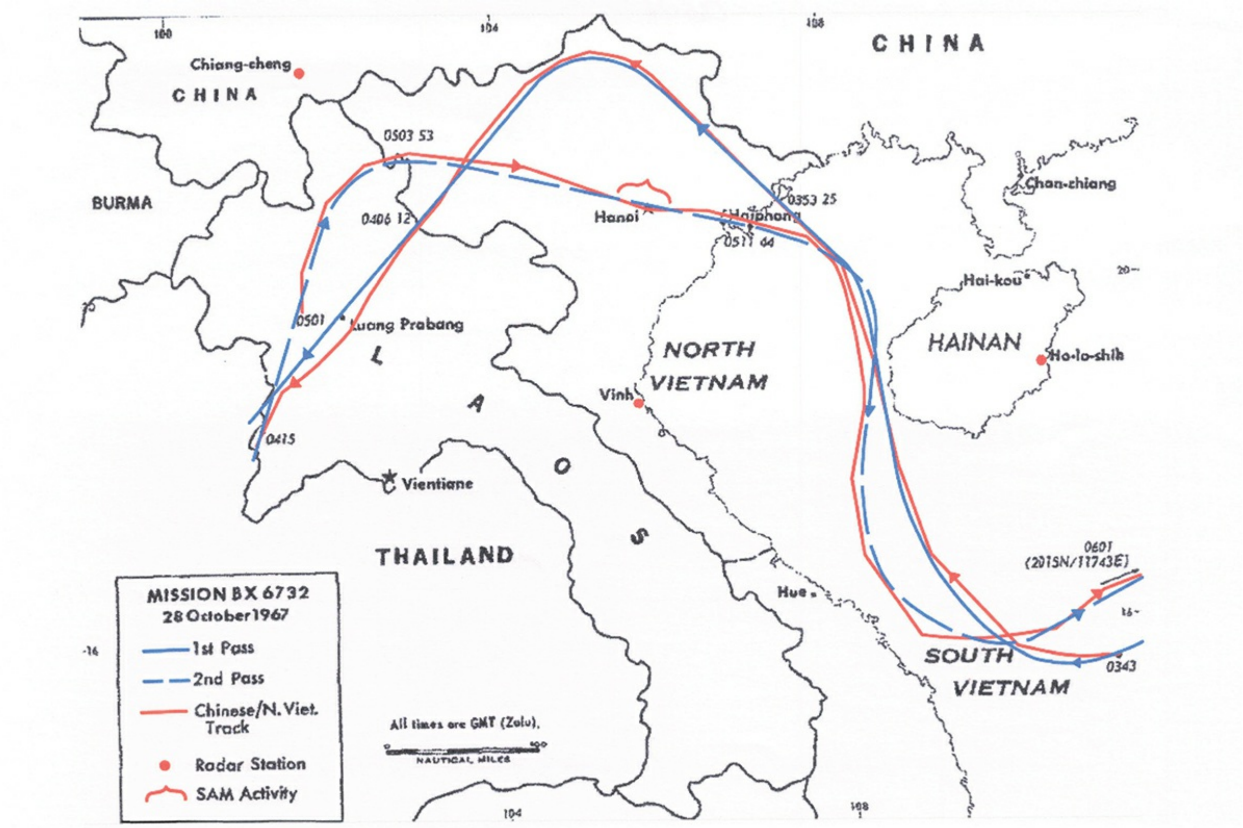
A POSSIBLE INTERCEPT SOLUTION

Weather interventions ensured that Black Shield missions BX6730 and 31, scheduled for 19 and 25 October, were cancelled. Ten days had elapsed since the last Oxcart incursion into North Vietnamese airspace. This one, flown on 28 October in Article 131 by Denys Sullivan and designated BX6732 (see map), was the sixteenth Black Shield mission.

Sullivan began his first pass at 03:53Z and completed it 13 minutes later. System 6 recorded four Fan Song signals, none of which were emanating from radars tracking the vehicle and as a result, none of '131's onboard defensive systems were activated.

His second pass began at 05:03Z and System 6 recorded three Fan Song signals, two of which were tracking 131. Then, five minutes later and at a range of 25.2nm, SAM site VN 133 launched a single SA-2. The missile failed to hit its target, but this was the first occasion that the North Vietnamese air defence system had attempted to actually engage an Oxcart.

A subsequent analysis of COMINT and System 6 tapes evidenced that the missile was launched while the Fan Song radar was operating in the low PRF mode (1,200– 1,265 pulses per second (pps), see Appendix 1). This mode extends the launch window of the SA-2, the modification was probably conducted in the field under the supervision of Soviet technical advisors. Without doubt, this was a concerted and viable attempt to engage the Mach-3 target since all previously known launches of SA-2s occurred with the Fan Song radar operating in the high PRF mode (21,400–21,530 pps), as this configuration was designed to intercept targets with a maximum velocity of Mach 2.


100
104
108
CHINA
Chiang-cheng
CHINA
BURMA
0503 53
0406 12
Hanoi
Haiphong
0353 25
0511 44
Chan-chiang
Hai-kou
20
HAINAN
Ho-lo-shih
0501
Luang Prabang
L
A
O
S
NORTH VIETNAM
Vinh
0415
Vientiane
THAILAND
Hue
0601
(2015N/11743E)
16
16
SOUTH VIETNAM
0343
MISSION BX 6732
28 October 1967
1st Pass
2nd Pass
Chinese/N. Viet. Track
Radar Station
SAM Activity
All times are GMT (Zulu).
Nautical Miles
104
108

BX6732 was the Oxcarts sixteenth Black Shield mission and was the first time that the North Vietnamese air defense system attempted a credible SA-2 intercept. (CIA, enhancement and colourization by Doug Fawkes)

The analysis concluded that:

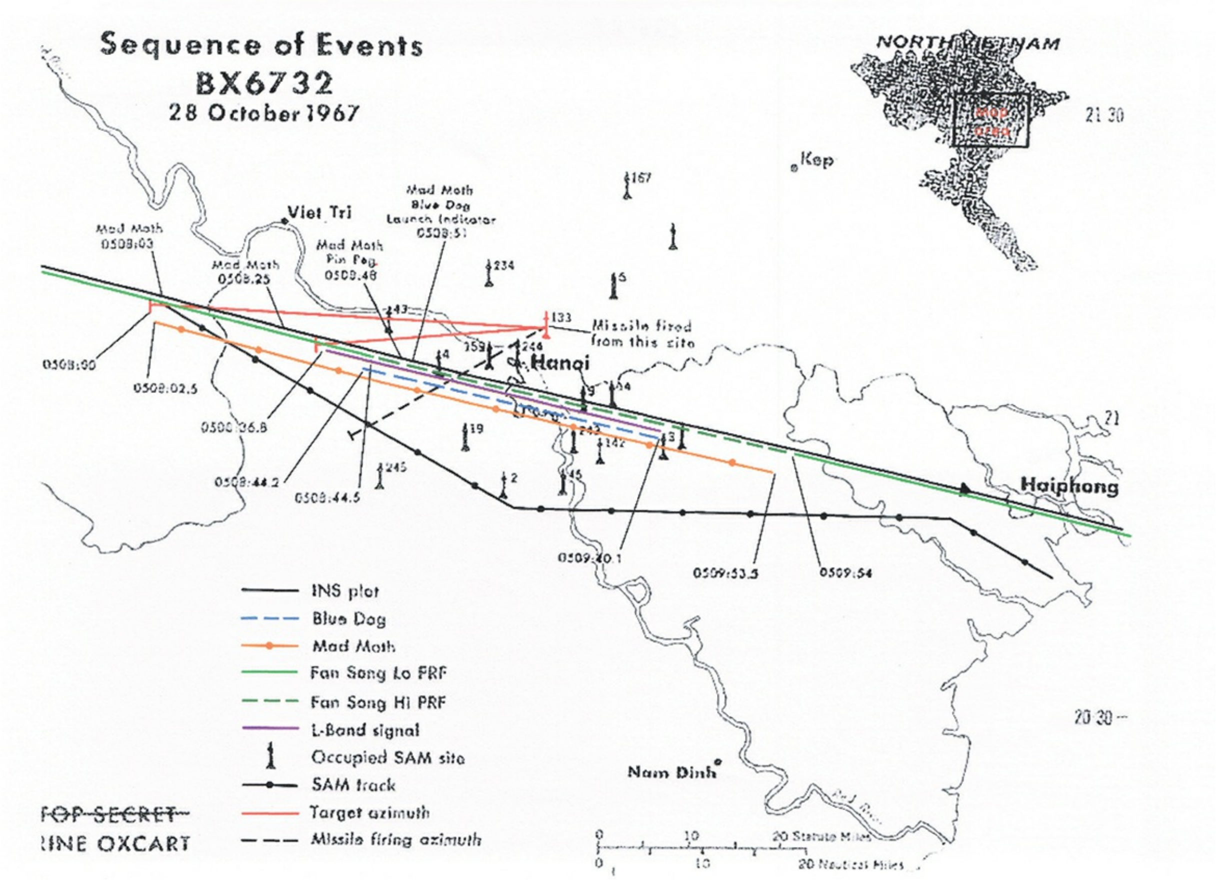
> the kill probability with the ECM equipment [then] on board the BLACK SHIELD vehicle remains essentially unchanged. The ECM equipment appeared to perform well against this first firing at the mission aircraft. While the low-PRF launch mode allows missile firings at ranges greater than the normal high-PRF launch range of 32 nautical miles, this particular missile launch occurred at a range of 25.2 nautical miles. The regimental controller criticized the SAM battalion controller for launching late, especially after the regimental controller had ordered a firing at 32.5 nautical miles.

Tracking of BX6732 was carried out by both Chinese and North Vietnamese air defence facilities and was characterized by the NSA as ‘in general complete and accurate’.

Mission photography showed a probable rail to road transhipment point under construction near Ho-kou, China, across the border from Lao Cai, North Vietnam. BX6732 also provided good coverage of all six major airfields in North

Vietnam and, with the exception of Haiphong/Cat Bi Airfield, all appeared to be serviceable. In total, 167 COMIREX targets and seven bonus targets were captured on film, of these 120 were North Vietnamese SA-2 sites of which 14 were occupied.

DoD strike/jamming reports indicate that 23 aircraft were conducting operations during the first overflight. During the missile launch of the second pass, just three DoD strike aircraft were conducting operations.



Sequence of Events
BX6732
28 October 1967
NORTH VIETNAM
Map area
21 30
Kep
Viet Tri
Mad Moth 0508:03
Mad Moth 0508.25
Mad Moth Pin Peg 0508.48
Mad Moth Blue Dog Launch Indicator 0508:51
167
234
5
133
Missile fired from this site
243
4
159
246
Hanoi
9
54
19
242
142
3
245
2
45
0508:00
0508:02.5
0508:36.8
0508:44.2
0508:44.5
0509:40.1
0509:53.5
0509:54
21
Haiphong
INS plot
Blue Dog
Mad Moth
Fan Song Lo PRF
Fan Song Hi PRF
L-Band signal
Occupied SAM site
SAM track
Target azimuth
Missile firing azimuth
20 30
Nam Dinh
~~TOP SECRET~~
LINE OXCART
0
10
20 Statute Miles
0
10
20 Nautical Miles

A detailed graphic depicting the events of 29 October. (CIA, enhancement and colourization by Doug Fawkes)

On 29 October, Frank Murray completed BX6733, another double-looper, this time in Article 127. The total mission time was three hours 56 minutes of which 20 minutes were spent over ‘denied territory’.

System 6 recorded eight Fan Song signals while ’127 was over North Vietnam. None of these appeared to be tracking the aircraft and none of its onboard ECM systems were activated.

During the first pass, there was no indication of air surveillance tracking by either the North Vietnamese or the Chinese. Nor were there any reported strike/jamming operations. However, Chinese air surveillance facilities tracked ’127 continuously during its second pass, but this was not the case for the North Vietnamese air defence system. With moderately heavy strike/jamming operations (38 aircraft) being conducted during this pass, the North Vietnamese chose not to participate in monitoring the Oxcart mission, despite the Chinese radar stations at Chiang cheng and Ho-lo-shih both passing track information – this could well be because of the danger presented by anti-radiation missile-toting Wild Weasel aircraft. Correlation of System 6 with the final position plot of the Ho-lo-shih radar station indicated the tracking radar to be a MOON FACE VHF radar.

The Phuc Yen regimental controller and subordinate SAM site VN 234 were noted in communications referring to the Black Shield mission, which was over the Gulf of Tonkin at the time and was never within VN 234’s firing zone.

Mission photography found evidence of continuing construction by Chinese engineers of Yen Bai Airfield – the first sign of progress since 20 June 1967. In all, 120 COMIREX targets were photographed, of these 74 were SA-2 sites, 16 of which were occupied. One new unoccupied SA-2 Site was also identified. As things turned out, this mission would prove to be the quiet before the storm.

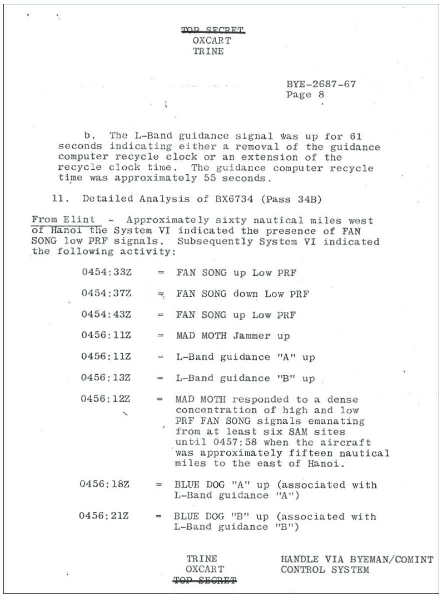
SO VERY CLOSE

The next day, when Denys Sullivan lowered himself into the cockpit of Article 129, he had no idea how intent ‘the children of the dragon’ were on interrupting the progress of BX6734 (see map). At 03:40Z, three minutes before entering North Vietnamese airspace on the first of two scheduled passes, two SAM battalions located at sites VN 234 and VN 142 attempted a missile launch. In the event, neither of the sites fired as they were beyond the required range limits for a successful interception. Subsequent analysis of System 6 tapes later indicated that a low-PRF launch, similar to the one experienced during mission BX6732 (28 October), did occur. Signal analysis coupled with the missile fly-out characteristics indicated the possible launching site to have been VN 167. Sullivan did not see a vapour trail or missile, and it is possible that the site fired at another aircraft. The intercepted Fan Song signal was weak; thus, 129's Mad Moth jammer activated for only a short period of time.

The event proved to be a portent of what was to follow. When Sullivan penetrated North Vietnamese airspace for his second pass at 04:45Z, SAM reactions had already been detected 25 minutes prior. Then, in an attempt to overwhelm '129's DEF system, at least six SAM sites fired between eight to ten missiles in a two-minute period from 04:56Z to 04:58Z. Sullivan saw these vapour trails and witnessed three SA-2 detonations.

An extract from Denny Sullivan's debrief report reads:

> The missiles were in a deep climb through the aircraft altitude of approximately 83,500ft, then they made a sharp push over to a moderate dive angle, levelled out at my altitude and guided toward the stern of the aircraft to detonate. The missiles varied slightly in azimuth compared to my line of flight in their climb, but all corrected in azimuth to an accurate dead stern position during push over and dive phase. [Missile altitude] estimated 90,000ft is probably quite close, but could vary a few thousand feet either way. It was not possible to view the entire contrail until down track a few miles due to narrow angle view in the rear periscope. [In this encounter the pilot was referring to three missiles.]



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OXCART
TRINE

BYE-2687-67
Page 8

b. The L-Band guidance signal was up for 61 seconds indicating either a removal of the guidance computer recycle clock or an extension of the recycle clock time. The guidance computer recycle time was approximately 55 seconds.

11. Detailed Analysis of BX6734 (Pass 34B)

From Elint - Approximately sixty nautical miles west of Hanoi the System VI indicated the presence of FAN SONG low PRF signals. Subsequently System VI indicated the following activity:

0454:33Z = FAN SONG up Low PRF

0454:37Z = FAN SONG down Low PRF

0454:43Z = FAN SONG up Low PRF

0456:11Z = MAD MOTH Jammer up

0456:11Z = L-Band guidance "A" up

0456:13Z = L-Band guidance "B" up

0456:12Z = MAD MOTH responded to a dense concentration of high and low PRF FAN SONG signals emanating from at least six SAM sites until 0457:58 when the aircraft was approximately fifteen nautical miles to the east of Hanoi.

0456:18Z = BLUE DOG "A" up (associated with L-Band guidance "A")

0456:21Z = BLUE DOG "B" up (associated with L-Band guidance "B")

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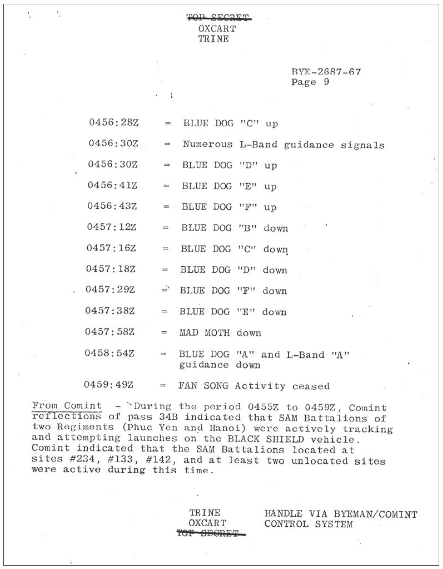
HANDLE VIA BYEMAN/COMINT
CONTROL SYSTEM



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OXCART
TRINE

BYE-2687-67
Page 9

0456:28Z = BLUE DOG "C" up

0456:30Z = Numerous L-Band guidance signals

0456:30Z = BLUE DOG "D" up

0456:41Z = BLUE DOG "E" up

0456:43Z = BLUE DOG "F" up

0457:12Z = BLUE DOG "B" down

0457:16Z = BLUE DOG "C" down

0457:18Z = BLUE DOG "D" down

0457:29Z = BLUE DOG "F" down

0457:38Z = BLUE DOG "E" down

0457:58Z = MAD MOTH down

0458:54Z = BLUE DOG "A" and L-Band "A" guidance down

0459:49Z = FAN SONG Activity ceased

From Comint reflections - During the period 0455Z to 0459Z, Comint reflections of pass 34B indicated that SAM Battalions of two Regiments (Phuc Yen and Hanoi) were actively tracking and attempting launches on the BLACK SHIELD vehicle. Comint indicated that the SAM Battalions located at sites #234, #133, #142, and at least two unlocated sites were active during this time.

TRINE
OXCART
~~TOP SECRET~~

HANDLE VIA BYEMAN/COMINT
CONTROL SYSTEM

Extract of CIA report covering the activation of Article 129's ECM systems. (CIA)

The report adds,

> Additionally, the pilot reported observing a missile approximately 100 to 200 yards to the right of the aircraft abeam the cockpit. It was in a 70 to 80° climb angle in the direction of aircraft flight. The missile was reported to have been rotating fairly fast about its vertical axis and appeared to the pilot to be the last detonation to be observed, as quoted in the paragraph above. In summary, the pilot felt that he saw at least six missile contrails and three detonations, all to the rear of the aircraft.

The report states that at least seven and possibly as many as ten SA-2s were fired at Article 129. Chinese and North Vietnamese air defence facilities continuously tracked Article 129 over North Vietnam and the Gulf of Tonkin. DoD strike/jamming activity was light during the first pass. In contrast moderately heavy strike/jamming operations (62 aircraft) were conducted during the second pass. These operations were being conducted in the Haiphong area, however, while the SAM launches occurred near Hanoi.

In total, BX6734 photographed 118 COMIREX targets, 92 of which were North Vietnamese SA-2 sites, 13 were occupied, including one newly identified site.

The seriousness of the attack prompted an investigation that was compiled by John Parangosky, who at the time was Acting Director of Special Activities, and it represented the coordinated views of the OSA, OSI and Office of ELINT (see Appendix 2). Its findings illustrate the Agency's ability to draw together various intelligence-gathering disciplines. Additionally, it demonstrates the ability of

Oxcart's ECM system to operate in an extremely dense signals environment and it equally reveals the determination of the North Vietnamese air defence network to 'bag a Blackbird'.

A North Vietnamese Army SA-2 battery reload. (Photo by: Pictures From History/Universal Images Group via Getty Images)

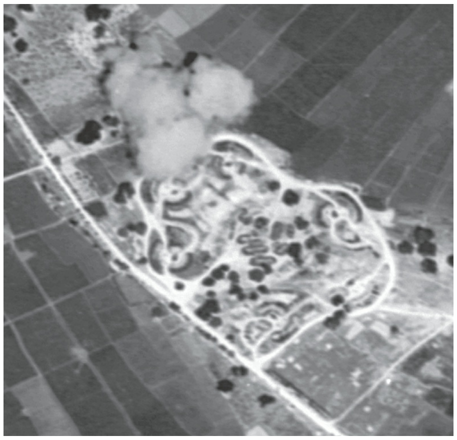
From photography captured on the film of Article 129's Perkin-Elmer Type 1 camera, the report established that:

> 13 SA-2 sites were occupied. Analysis of six SA-2 vapor trails which appeared in photography taken from 04:57:04Z to 04:57:18Z indicated that sites #234, #244, #133, and a newly identified site located west of Hanoi launched a total of five missiles in the direction of the *Black Shield* vehicle. No information could be obtained from the sixth vapor trail that would indicate its launch site. Additional photography of sites #14 and #142 indicated that several launchers (3 and 2 from #14 and #142 respectively) and their FAN SONG radars were pointed in the direction of the *Black Shield* vehicle. Analysis of all the data indicates that sites #234, #133, #142, #14, #244 and the new site were active and most probably launched six to nine missiles at the aircraft.

The report concluded that analysis of System 6 indicated that the aircraft's DEF system performed as designed, jamming effectively in a multi-signal environment. The report detailed a total of four significant findings that are worth quoting in full:

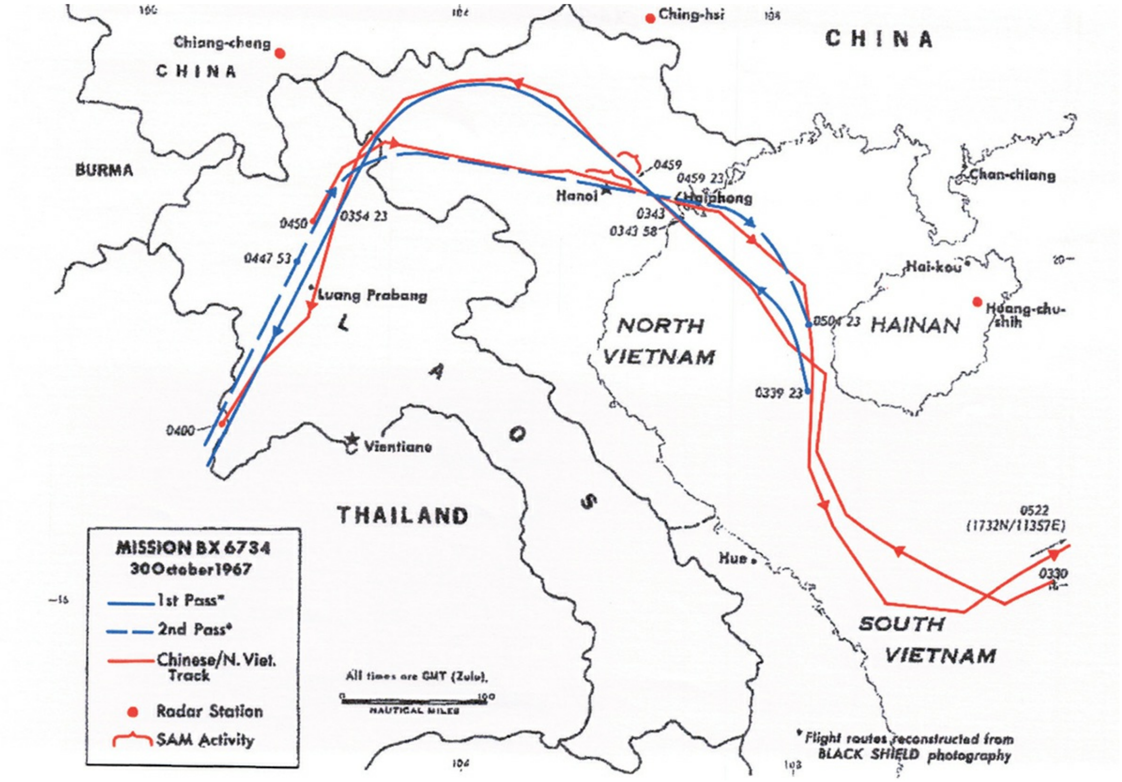
> a) Although not readily apparent it appears that the Low-PRF launch mode was employed on at least the first two firings of pass 34B. The signal density following these launches precludes any statements regarding Low-PRF launch of the other firings.
> b) The guidance computer recycle time of 55 seconds has apparently been extended or the clock removed from the system, as evidenced by the duration of L-Band guidance signals (34A, 61 seconds – 34B, 163 seconds).
> c) Spoof and/or saturate EW systems – The duration of the L-Band signal of pass 34B (163 seconds) and the nature of the guidance commands (unrealistically small for an intercept of the vehicle), indicate there may have been an attempt to spoof the BLUE DOG jammer. Also, NPIC analysts indicate that within the limits of their photography of BX6734, there was a heavier than usual concentration of occupied SAM sites in the Hanoi area. Furthermore, *Black Shield* photography did not reveal any occupied sites in the Haiphong area. It may be that SAM battalions were moved into the Hanoi area from other areas specifically in an attempt to concentrate fire on a repetitive area of *Black Shield* routes. This enhanced, as far as the Soviets/Vietnamese may have concluded, their ability to saturate MAD MOTH.
> d) Relevant findings resulting from the pilot's comments: The pilot reported a missile rotating fairly fast about its vertical axis approximately 100–200 yards to the right of the aircraft and abeam the cockpit. The SA-2 Mod I missile rotating about its longitudinal axis is a missile out-of-control and will no longer answer to any guidance commands. It seems extremely unlikely that an out-of-control missile could perform a 'push over', dive and correct in azimuth to a dead stern position. It appears to be more probable that the pilot observed two different missiles; one climbing abeam of the aircraft, and another detonating some few seconds later to the rear of the aircraft. Although the rotation of the missile about its longitudinal axis may have been caused by the on-board jammers; it is not possible at this time to positively state that this was the actual cause of rotation.

From the analysis, it was deduced that the increased launch range capability of the Democratic Republic of Vietnam (DRV) SA-2 system in low PRF would definitely increase the kill probability under conditions of Oxcart jammer malfunction. However, it considered that this increased capability against an Oxcart with a fully operational ECM system was still 'essentially zero'.



During BX6732's second pass over North Vietnam, a single SA-2 from SAM site VN 133 was launched. This was the first time an A-12 had been attacked by a missile and its smoke, shortly after launch, is clearly visible in this image. (National Archives via Lin Xu)

Having been fired upon by a single SA-2 on 28 October, Dennis Sullivan (stateside call sign Dutch 23) had an extremely lucky escape two days later. (CIA)


Ching-hsi
Chiang-cheng
CHINA
CHINA
BURMA
Chan-chiang
Hanoi
Haiphong
0459
0459 23
0343
0343 58
0450
0354 23
0447 53
Luang Prabang
L
A
O
S
0400
Vientiane
NORTH VIETNAM
Hai-kou
Hoang-chu-shih
HAINAN
0504 23
0339 23
THAILAND
Hue
0522
(1732N/11357E)
0330
SOUTH VIETNAM
MISSION BX 6734
30 October 1967
1st Pass*
2nd Pass*
Chinese/N. Viet. Track
Radar Station
SAM Activity
All times are GMT (Zulu).
0
100
NAUTICAL MILES
* Flight routes reconstructed from BLACK SHIELD photography

Map detailing the concerted effort made by the North Vietnamese to intercept BX6734. (CIA, enhancement and colourization by Doug Fawkes)

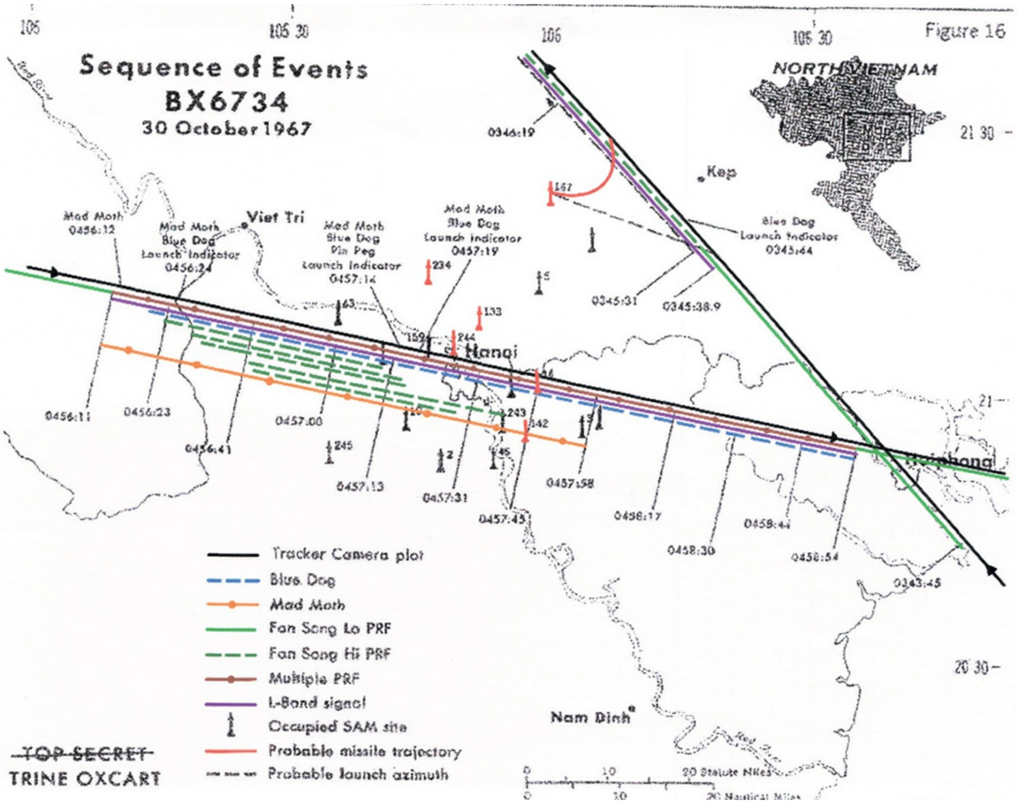


Figure 16
Sequence of Events
BX6734
30 October 1967
105
105 30
106
106 30
21 30
21
20 30
NORTH VIETNAM
Kep
Viet Tri
Hanoi
Haiphong
Nam Dinh
Red River
Mad Moth
0456:12
Mad Moth
Blue Dog
Launch Indicator
0456:24
Mad Moth
Blue Dog
Pin Peg
Launch Indicator
0457:14
Mad Moth
Blue Dog
Launch Indicator
0457:19
Blue Dog
Launch Indicator
0345:44
0346:19
0345:31
0345:38.9
0343:45
0456:11
0456:23
0456:41
0457:00
0457:13
0457:31
0457:45
0457:58
0458:17
0458:30
0458:44
0458:54
167
234
133
244
159
5
63
243
342
245
2
45
Tracker Camera plot
Blue Dog
Mad Moth
Fan Song Lo PRF
Fan Song Hi PRF
Multiple PRF
L-Band signal
Occupied SAM site
Probable missile trajectory
Probable launch azimuth
~~TOP SECRET~~
TRINE OXCART
0
10
20 Statute Miles
0
10
20 Nautical Miles

A detailed graphic depicting the events of 30 October. (CIA, enhancement and colourization by Doug Fawkes)

With 129 safely recovered back at Kadena without further incident, a post-flight inspection revealed that a tiny fragment from the missile had penetrated the aircraft's right aft fillet and lodged in the support structure surrounding the number five fuel tank. It was established however that this was not from the missile's warhead. With six missiles having been positively identified as having been fired at the Oxcart, with each warhead packed with 3,600 'pellets', it means that the airspace in the vicinity of 129 was subjected to a storm of no less than 21,600 of the deadly prills. During the mission, Sullivan reached a maximum speed of Mach 3.44, that's 2,294kt or 3,871ft per second. To get this close to such a fast-moving target demonstrates how all the work by the North Vietnamese air defence system (with help from their Soviet advisors and the Chicom radar network), almost paid off! As things turned out, history would record the missile fragment as having caused the only 'damage' ever inflicted by an enemy on a Blackbird.

The sheer scale and ferocity of the SA-2 ambush of 30 October must have caught the Black Shield planners off-guard. Whilst a report into the attack was being compiled, Black Shield missions were suspended. Inclement weather conditions forced the cancellation of missions BX6735 and 36 and it was 39 days before they resumed.

A NEW AREA OF INTEREST

Flown on 8 December 1967 by Mele Vojvodich in Article 131, Black Shield mission BX6737 was a single high-altitude pass over the Cambodian/South Vietnamese and Laotian/North Vietnamese border areas. After the October 30 mission, this was a proverbial 'walk-in-the-park'. No threat signals were recorded on System 6 and no onboard ECM systems were activated during the overflight. Air surveillance tracking lasted approximately 10 minutes and was carried out by Chinese radar facilities – there were no indications that North Vietnam were aware of the mission.

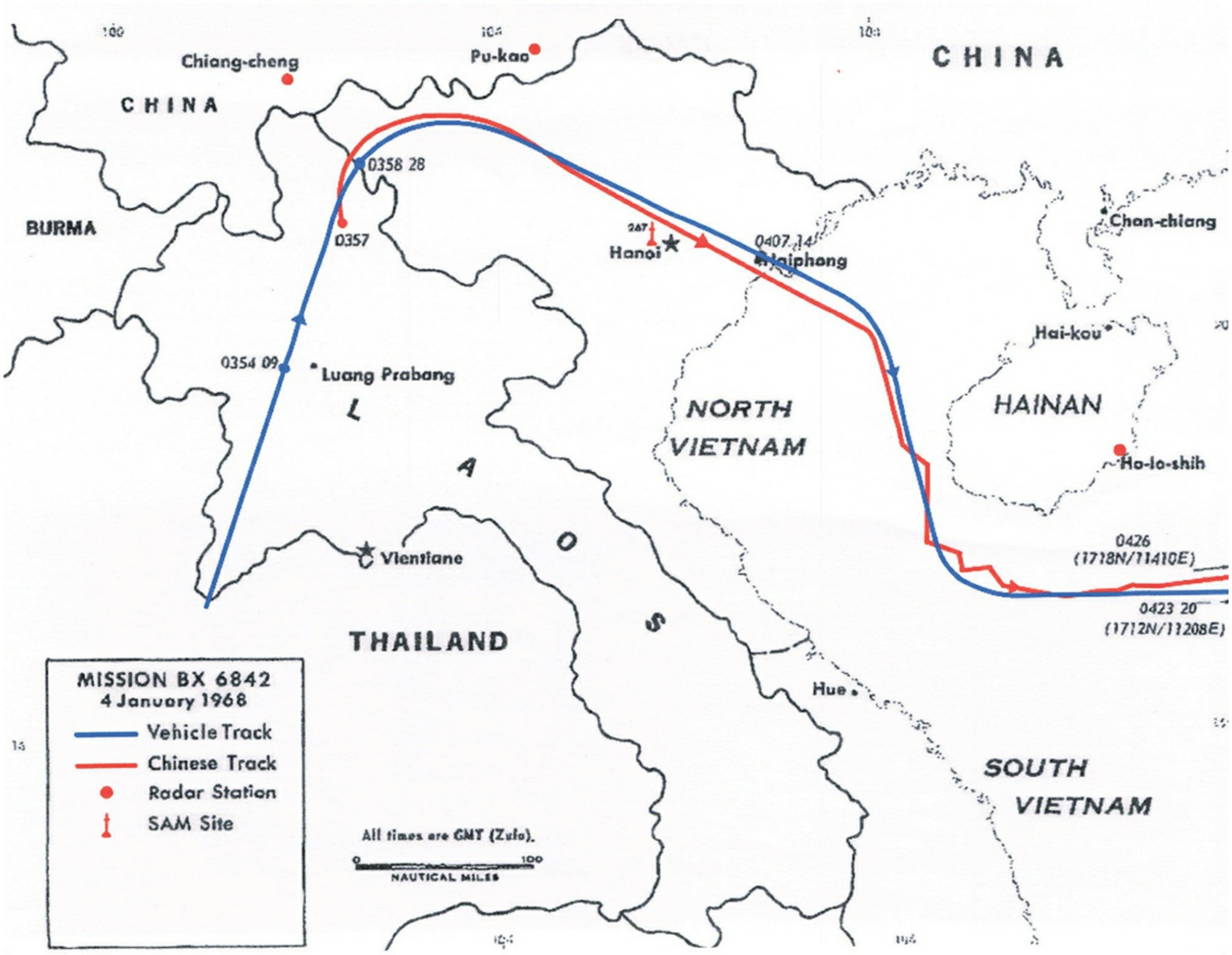
The three-hour-59-minute mission entered Southeast Asia at 03:40Z and exited at 05:06Z. Article 131's Perkin-Elmer Type I camera system targeted seven specific priority search areas in northeastern Cambodia, southeastern Laos, and adjacent South Vietnam, searching for evidence of Viet Cong or North Vietnamese activity. Unfortunately, cloud cover obscured four of the search areas, although limited troop activity at the point where the Tonle San River crosses the Cambodia/Laos border was detected, together with the re-grading of the natural surface runway at Ban Pania airfield. Several troop encampments, served by numerous trails extending north to Cambodian Route 97 were also detected, in addition to a probable new storage area and water-to-road trans-shipment point.

Two days later, on 10 December, Jack Layton flew Article 131 on another single pass over the Cambodian, Laotian, and South Vietnamese tri-border area. Mission BX6738 lasted three hours 51 minutes, of which 18 minutes were dedicated to imaging the target area, although the mission was not without incident. As Jack recalled,

> The INS caused the aircraft to overshoot the planned track during turns, causing me to 'penetrate the bamboo curtain' into North Vietnam. After turning south and getting back to an approximate course toward Scope Pearl, I had difficulty finding the tankers due to thick cloud and poor visibility. I got the aircraft up in a bank to search for the tankers, but the visibility from an A-12 is very poor; you can

> look down and see the ground but you can't look inside the turn because of the canopy roof. I'd just about reached the point where I was about to divert to Takhli due to the lack of fuel when I finally saw the tankers. We got together and I was able to complete the mission even though the INS wasn't working.

Back at Yakota AB, the 67th Recce Tech detected a new, probable trans-shipment-storage facility on the Tonle Son River in Cambodia near the South Vietnamese border. The Photo Interpreters also noted a heavily used trail extending from Cambodia into the northwestern corner of Darlac Province in South Vietnam. Two automatic weapons positions were observed near the trail just inside the Cambodian border. During the mission, no threat signals were recorded, no aircraft defensive systems were activated, and there was also no evidence of air surveillance tracking by either the Chinese or North Vietnamese.


Chiang-cheng
Pu-kao
CHINA
CHINA
BURMA
0358 28
0357
267
Hanoi
0407 14
Haiphong
Chan-chiang
0354 09
Luang Prabang
L A O S
NORTH VIETNAM
Hai-kou
HAINAN
Ho-lo-shih
Vientiane
0426
(1718N/11410E)
0423 20
(1712N/11208E)
THAILAND
Hue
SOUTH VIETNAM
MISSION BX 6842
4 January 1968
Vehicle Track
Chinese Track
Radar Station
SAM Site
All times are GMT (Zulu).
0
100
NAUTICAL MILES

Another SA-2 attack was conducted during the course of BX6842. (CIA, enhancement and colourization by Doug Fawkes)

Jack Layton (stateside call sign Dutch 27) pictured in his David Clark S-901 pressure suit, completed six Black Shield missions. He was fired at by an SA-2 during BX6842. (Lockheed Martin)

Missions over North Vietnam finally resumed on 15 December, when Mel Vojvodich flew Article 127 on a double-looper. Following events of 30 October, the mission profile over North Vietnam was flown higher than earlier sorties, with Vojvodich taking #127 up to 86,000ft. In total, the BX6739 mission lasted four hours and nine minutes, of which 20 minutes were spent in denied airspace. Despite being tracked by both the Chinese and North Vietnamese air defence networks (and specifically the Bai Thuong North Vietnamese radar station, that reported two position plots of the vehicle during the second loop), the sky remained clear of SA-2s. DoD strike/jamming operations were conducted throughout the overflight period and System 6 recorded just three Fan Song signals, none of which appeared to be tracking the vehicle, and no onboard ECM systems were activated.

Through clear skies, mission photography was able to determine that all of North Vietnam's major airfields, except Haiphong/Cat Bi appeared to be serviceable. In total, 195 COMIREX targets were imaged, 142 of which were North Vietnamese SA-2 sites – 18 of them were occupied.

The next day it was Jack Layton's turn to venture 'North' in Article 131. The double loop mission lasted three hours and 56 minutes, during which time #131 reached an altitude of 86,200ft – the highest altitude achieved during Operation Black Shield. Chinese air surveillance facilities tracked the Oxcart sporadically, but there was no indication of North Vietnamese awareness of the aircraft. During moderate DoD strike/jamming operations, System 6 recorded six Fan Song signals, again, none of which appeared to be tracking 131 and no onboard defensive systems were activated.

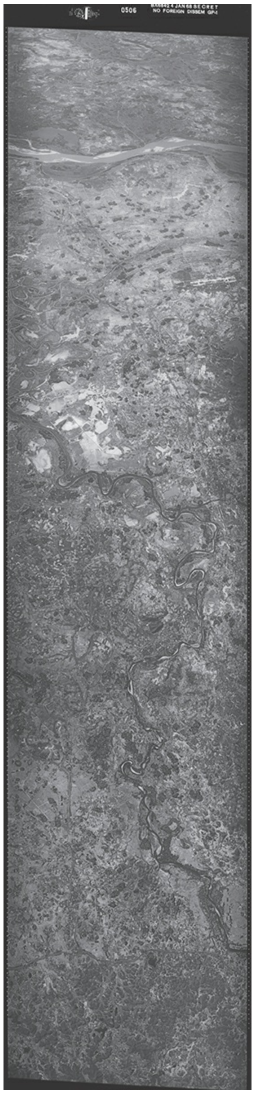
Mission photographs obtained about 60 per cent cloud-free coverage of the target area, enabling 86 COMIREX targets to be imaged, 74 of which were SA-2 sites, two of which were occupied. As a result of these two back-to-back missions, BX6739 and BX6740 photographed 221 of North Vietnam's 226 useable SA-2 sites, including six new sites – 20 of which were occupied, including five of the six new sites.

Another weather intervention caused BX6741, scheduled for 22 December 1967, to be scrubbed. It therefore fell to Jack Layton to kick off activity in the New Year with mission BX6842, when on 4 January 1968 he completed a single pass in Article 127 – this was not however without incident (see map). Strike/jamming activity during the overflight period was moderate and restricted to the Haiphong area. Early warning tracking was first established by the Chinese radar facility at Chiang-cheng and was supplemented by information provided by Pu-kao and Ho-lo-shih. Although there was no indication of North Vietnamese radar tracking, it is likely that the North Vietnamese broadcast of the vehicle's track was based upon receipt of Chinese plot information.

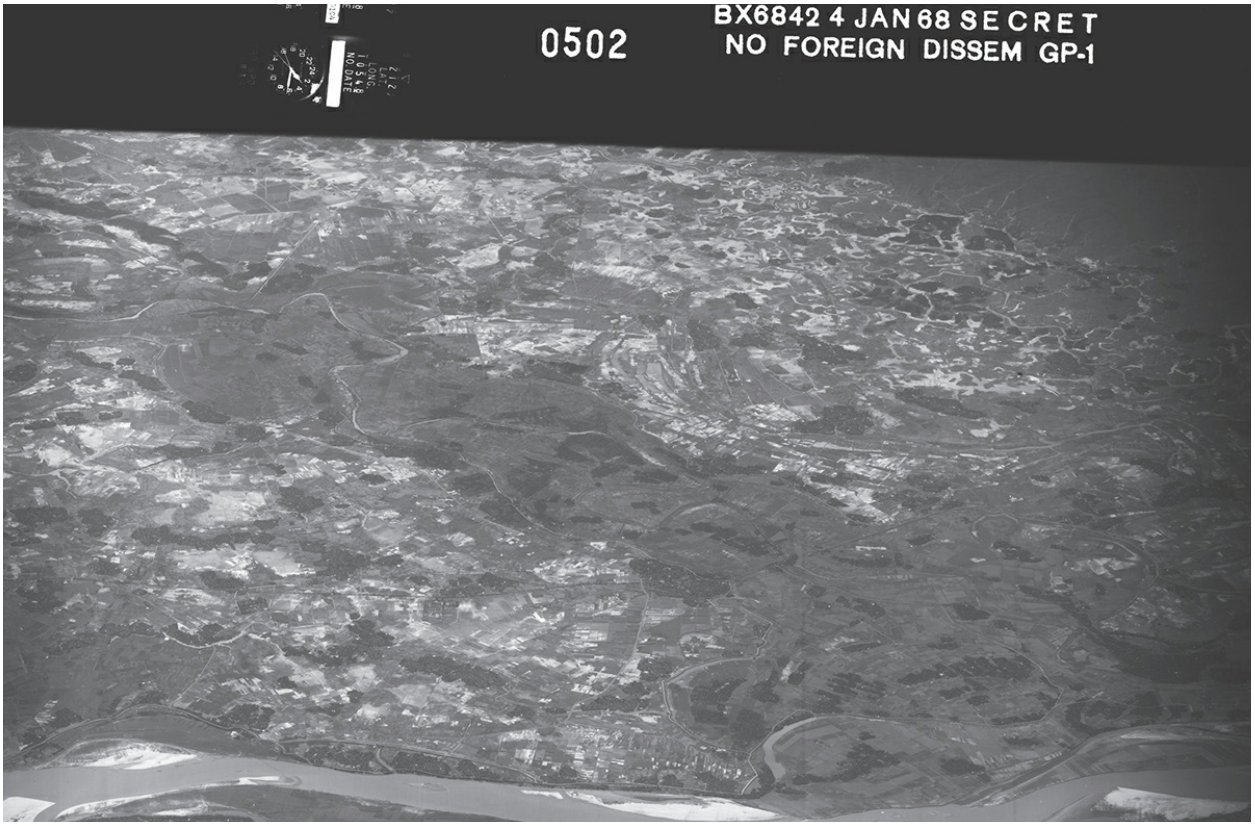
At 04:05Z, two minutes before Article 127 exited North Vietnamese airspace, it encountered a SAM reaction. During intentional missile launch sequences directed at Oxcarts that were observed in October on missions BX6732 and BX6734, the missiles were launched while the radar was in low PRF. The Fan Song was switched to high PRF in two of these firings approximately six seconds after launch, and missile guidance was provided thereafter. In their continuing quest to refine SA-2 launch techniques to an extent that the missile would finally intercept an Oxcart, a departure from normal Fan Song B launch/guidance techniques was noted on this mission. Normal operational procedures specified launch/guidance to occur while the target and missile were under the influence of the Fan Song radar operating in the high-PRF mode (2,400–2,530pps). On this occasion, Site 267 launched an SA-2 at #127 while the radar was in the low-PRF mode and missile guidance information, usually transmitted in high-PRF, was computed with the radar operating in the low-PRF mode. This atypical launch/guidance sequence may have been an attempt by the North Vietnamese to reduce the effect of the aircraft's jammers while suffering only a small loss in capability due to the lower data transfer rate. However, the launch was based upon erroneous early warning (EW) tracking information, which projected the target flight path to be within 4nm of the SA-2 site. The aircraft's actual flight path was approximately 20nm from site 267 and too distant for a successful intercept. The erroneous EW tracking data, coupled with the effects of the aircraft's jammers resulted in a late and probably hasty launch that could not have been successful because of the large offset range. The missile continued to automatic destruct, which occurred approximately 62 seconds after launch. This was also the approximate duration of the LO band signal.

Of the 176 COMIREX targets photographed during BX6842, 139 were North Vietnamese SA-2 sites, 12 of which were occupied. Imagery was also captured of a number of probable cave defence sites near Hanoi and Haiphong. One L-band and three S-band, Fan Song B radar signals were recorded during the overflight. The third S-band signal qualified as a valid threat and activated the Mad Moth and Blue Dog jammers. These signals were attributed to site 267 and the SA-2 launch. Correlation and analysis from photography indicated the missile's approach to Article 127 was no closer than 8,000ft and was probably much greater.

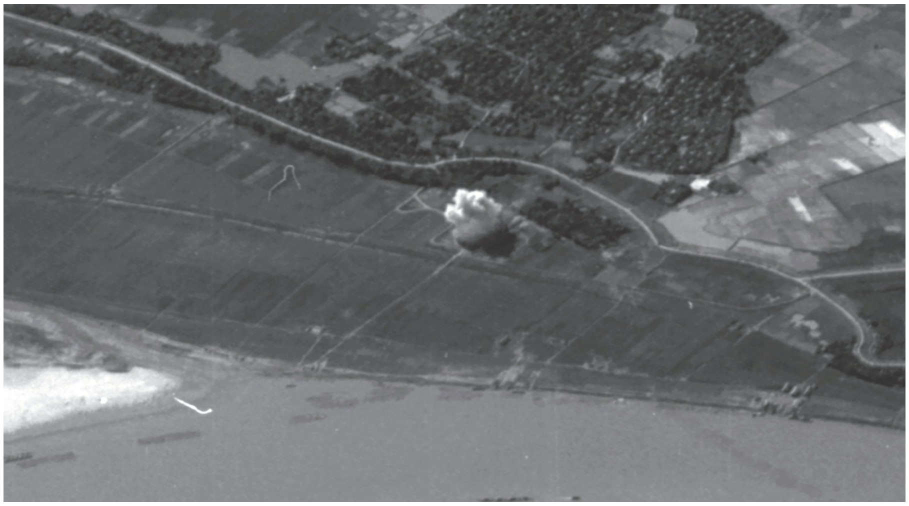
The next day, on 5 January 1968, BX6843 was executed by Jack Weeks flying Article 131. The double pass remained in enemy airspace for a total of 24 minutes. There was little to no strike/jamming activity during the overflight period. Initial EW tracking was accomplished by the two Chinese facilities at Chiang-cheng and Pu-kao, and the track information was subsequently broadcast by the North Vietnamese, although there was no indication of tracking by the North's radars. In all, 11 Fan Song B, S-band signals were recorded, one of which appeared to be tracking #131, but no aircraft defensive systems were activated.


0506
BX6842 4 JAN 68 SECRET
NO FOREIGN DISSEM GP-1

The entire file strip of frame 506 from BX6842. (National Archives via Lin Xu)


0502
BX6842 4 JAN 68 SECRET
NO FOREIGN DISSEM GP-1

Close study by the photo interpreters of the top portion of frame 502 revealed a smoke plume from the SA-2 when it was launched from site 267 at the Oxcart. (National Archives via Lin Xu)

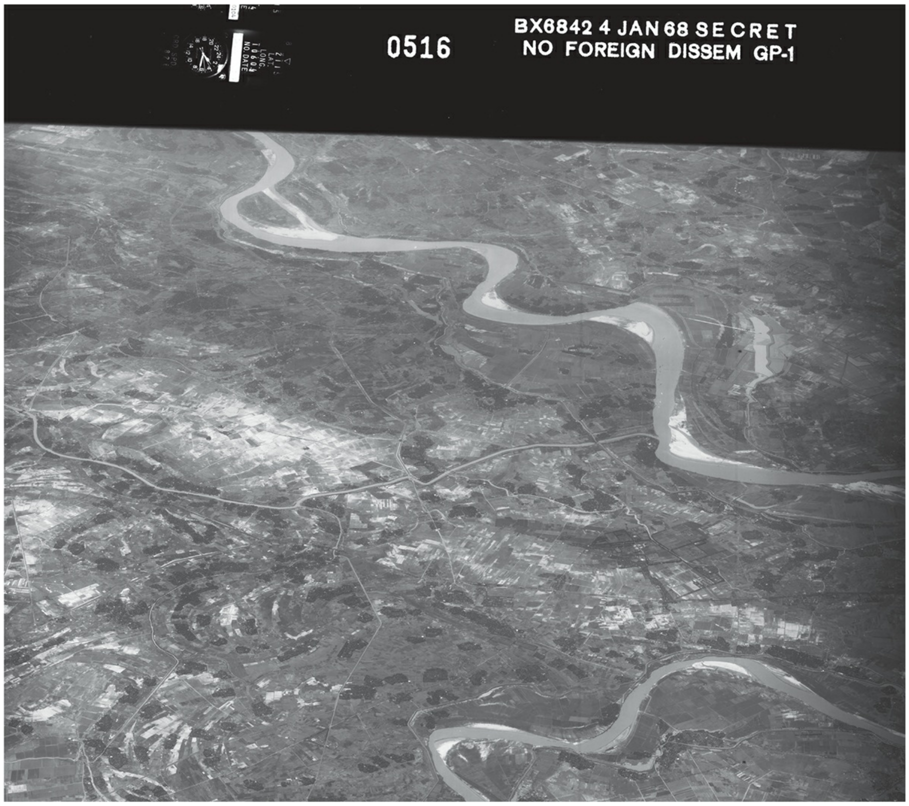


A closer look at the smoke plume. (National Archives via Lin Xu)

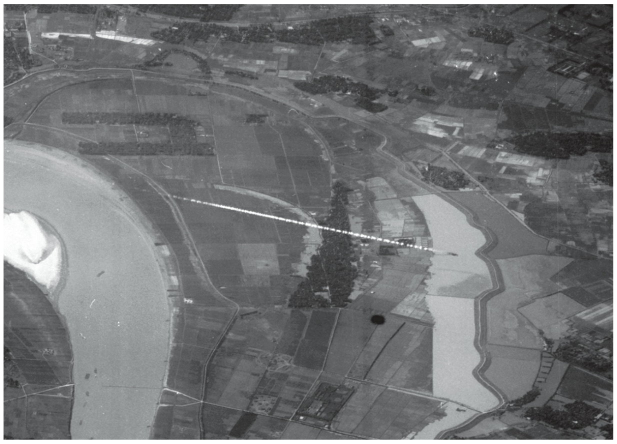
The platform's cameras imaged two suspect SS (cruise) missile sites near

Thanh Hoa, one containing a few small unidentified objects and the other unoccupied. In addition, 233 Chinese and North Vietnamese COMIREX targets were photographed, plus 10 bonus (non-COMIREX) targets. Of the COMIREX targets, 182 were North Vietnamese SA-2 sites, 15 were occupied. This mission also provided photography of five of North Vietnam's major airfields and coverage of almost all of the rail network.

Three more scheduled Black Shield missions, BX6844, 45 and 46, due to have taken place on January 6,19 and 20 respectively, were cancelled due to bad weather over the collection area. However, as the weather finally began to improve, the frosty political temperature that existed between North Korea and the United States was about to take a nose-dive.



A study of the top right area of frame 516 revealed the short vapour trail of a SA-2 in flight. (National Archives via Lin Xu)



Enlarged, it was established that the missile was fired late and remained on a chase course to the right of the Oxcart whilst climbing towards its target. It exploded 62 seconds after launch in 'automatic destruct'. (National Archives via Lin Xu)

TARGET, NORTH KOREA

In a CIA document classified Top Secret but approved for release in June 2002, the rationale was outlined for Oxcart reconnaissance missions against North Korea. It stated that the belligerent pronouncements by North Korean civil and military leaders and an increase in the number and expanded scope of North Korean probes along the DMZ, coupled with its efforts to establish the structure for guerrilla operations in the South, had established a critical requirement for accurate intelligence.

It further noted that satellite photos had not provided adequate imagery of North Korea to satisfy the requirement, and that ground collection of this intelligence was becoming increasingly difficult; taken together, this had made an accurate estimate of capabilities and intentions all but impossible. It continued that the operational concept could now be accomplished on a 24-hour alert basis, using Black Shield assets in place at Kadena, without coverage degradation of targets in North Vietnam.

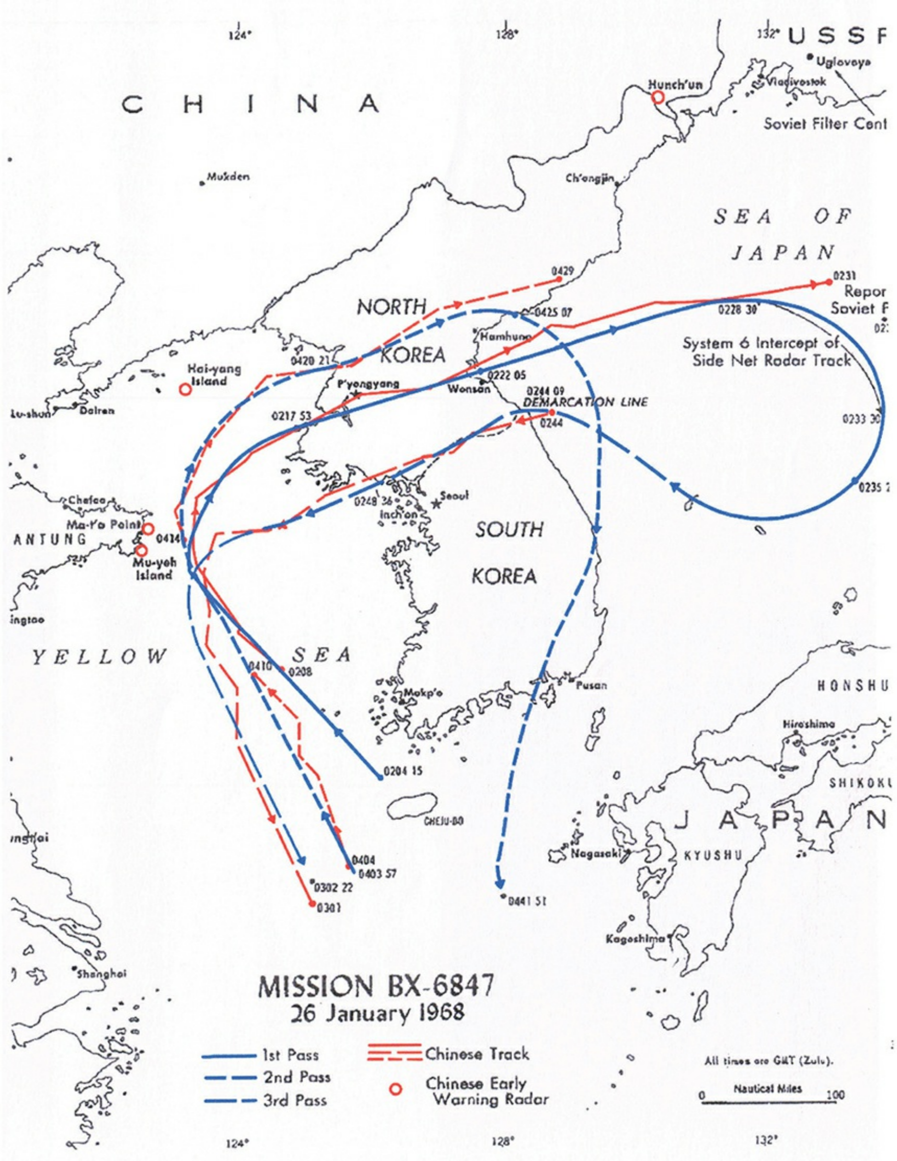
Three passes traversing the target areas east to west or west to east could be accomplished with two air refuellings, or two passes of similar orientation could be executed with a single air refuelling. All routes provided flexibility to adjust photographic flight lines to meet changing weather and/or target requirements.

It further noted that penetration of denied territory would be accomplished at 76,000ft or above at Mach 3.1. Emergency or missed air refuelling divert bases would be in South Korea, but in all other circumstances launch and recovery would be from Kadena.

The document's air defence analysis noted that there were 13 known SA-2 sites in North Korea and, as no airborne jamming would be undertaken by other US airborne assets, the threat of a possible SAM reaction from North Korean SA-2 systems was deemed greater than in the skies over North Vietnam. For this reason, Oxcart flight over SAM-defended areas of North Korea was to be conducted above 80,000ft and at a speed of Mach 3.2 to provide maximum protection. It also noted that there were 30 or more Soviet SA-2 C-band and possibly S-band sites in the Vladivostok area, the furthest known sites to the south of this enclave being approximately 75 miles from the North Korean border.

USS *Pueblo* (AGER-2) and her crew became the focus of a major international incident when she was boarded and captured by North Korea. (US Navy)

Jack Weeks (stateside call sign Dutch 29) completed BX6837 on 26 January 1968, during a mission to locate the beleaguered USS *Pueblo*. (Lockheed Martin)


124°
128°
132°
USSR
CHINA
Mukden
Hunch'un
Uglovaya
Vladivostok
Soviet Filter Cent
Ch'ongjin
SEA OF JAPAN
0429
0231
Repor
Soviet F
NORTH KOREA
0425 07
0228 30
Hamhung
System 6 Intercept of Side Net Radar Track
Hai-yang Island
0420 21
P'yongyang
0222 05
Wonsan
0244 09
DEMARCATION LINE
0244
0233 30
Lu-shun
Dairen
0217 53
0235
Chefoo
0248 36
Inch'on
Seoul
Ma-Yo Point
0414
ANTUNG
Mu-yeh Island
SOUTH KOREA
ingtao
YELLOW SEA
0410
0208
Mokp'o
Pusan
HONSHU
Hiroshima
0204 15
SHIKOKU
CHEJU-DO
JAPAN
KYUSHU
Nagasaki
0404
0403 57
0302 22
0301
0441 51
Kagoshima
Shanghai
MISSION BX-6847
26 January 1968
1st Pass
2nd Pass
3rd Pass
Chinese Track
Chinese Early Warning Radar
All times are GMT (Zulu).
Nautical Miles
0
100

The first Black Shield overflight of North Korea (BX6847) successfully located USS *Pueblo*. It was, however, monitored throughout by Chinese radar facilities. (CIA, enhancement and colourization by Doug Fawkes)

In relation to the airborne threat, it stated there were no aircraft in the North Korean air order of battle that were a threat to Oxcart; however, it noted that the Soviet YAK-28 'Firebar' had an intercept capability against the A-12 and that 21 such aircraft were based at Spassk Dalnij East, approximately 175 miles from the closest Oxcart flight path and 125 miles north of the North Korean border.

In summary, it concluded that although a somewhat higher total threat potential existed for the proposed mission compared to North Vietnam, the surprise element could well prevent an effective response, particularly during early sorties. In a final point, especially in relation to any 'incidents', it noted that in the event that any such sortie required implementation of an official contingency, the aircraft would be described as an unarmed reconnaissance aircraft engaged in surveillance of activities in the demilitarized zone between North and South Korea and that intentional overflight of North Korea would be denied.

On a footnote, at the bottom of a sample route map, it added that photographic resolution would be in the order of 1ft to 3ft 6in and that two eastbound and one westbound pass over the North would take just 17 minutes to complete. Despite this, the US State Department vetoed the plan.

In late 1967 DCI Richard Helms requested the Committee on Imagery Requirements and Exploitation to prepare a briefing document concerning reconnaissance of North Korea. Two earlier pieces of work in this regard had been carried out (including one by the Commander, US Forces Korea) and the other by the Board of National Estimates which had recommended 'increased efforts in the collection and analysis of political, economic and military information, particularly on the subjects of North Korea intentions toward the South.'

The Top Secret COMIREX memo, dated 9 October 1967, drew reference to both of these earlier recommendations and also made reference to other reconnaissance assets that had been available for use against North Korea, including, in subsection A of paragraph 3, KH-4 [satellite] Mission 1101 during the period 21–28 September 1967, which had provided usable photography of more than 85 per cent of North Korea and, in subsection C of the same paragraph, 'U-2 – North Korea was last covered by the U-2 Tackle programme on 31 July 1965. The programme is currently stood down; but even if a U-2 mission were attempted against North Korea, it would now have only limited access because of the SAM sites which protect much of the interior of the country'.

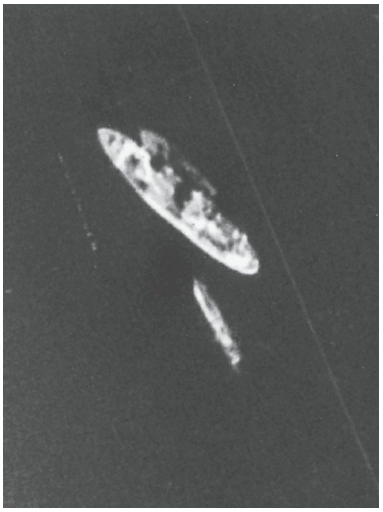
The memo ended by observing that Black Shield could, subject to weather, provide the necessary coverage of the country within a short period of time and that this would be of 'substantial assistance in correcting the intelligence deficit on the North Korean military posture and in providing a new baseline against which to check other intelligence as may be available.' Yet again, no immediate action was taken.

THE *PUEBLO* AFFAIR

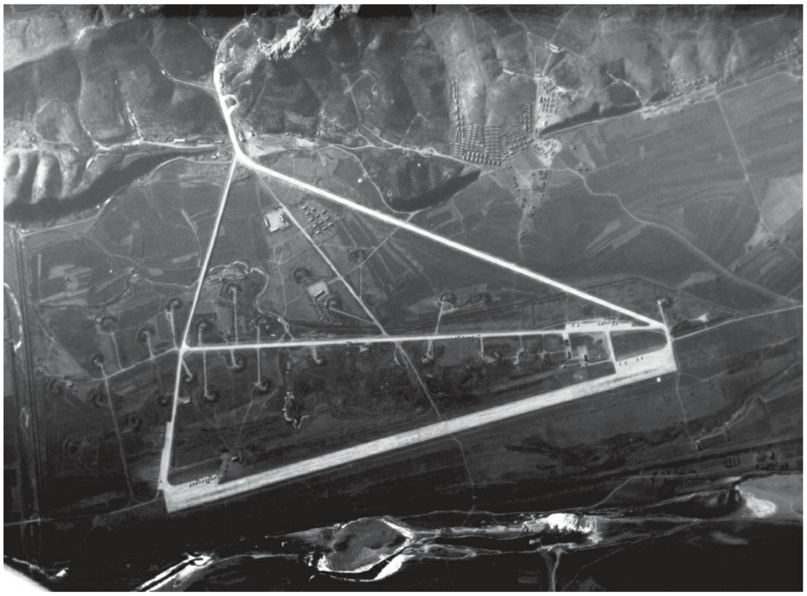
In an April 1965 intelligence planning meeting, it had been decided to establish a small fleet of signals intelligence ships similar to the Soviet fleet of 40 such vessels that operated near the United States and in many other strategic points around the world. The decision received prompt approval from Director of Defence Research and Engineering, Dr Harold Brown, and from Deputy Secretary of Defence Cyrus Vance, for the implementation of a two-phase plan.

In Phase One, USS *Banner* was transformed into Auxiliary General Environmental Research Ship 1 (AGER-1) and duly steamed out of Washington State's Puget Sound Naval Shipyard on the first of its planned 16 sea patrols in the western Pacific. Meanwhile, two Army supply ships, *FS-344* and *FS-389*, were re-christened as USS *Pueblo* (AGER-2) and USS *Palm Beach* (AGER-3). By 1 December 1967, the extensive modification programme was complete and *Pueblo* joined *Banner* in Yokosuka Harbour, Japan. By then, *Banner* was a veteran on intelligence surveillance duties. While at Yokosuka, a six-month schedule was drafted covering nine separate missions, five of which were tasked by the NSA.

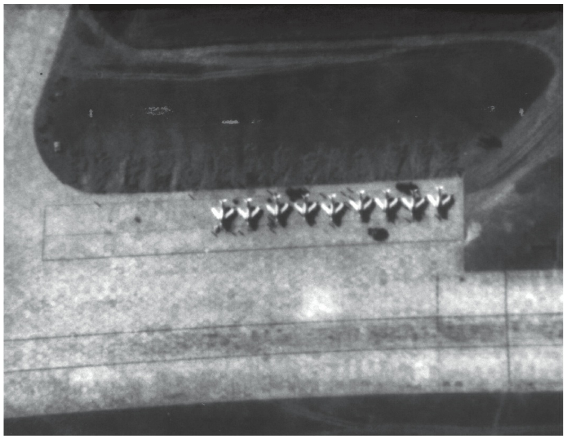
The *Pueblo*'s first sortie was tasked by the US Navy and called for the ship to 'sample the electronic environment off the east coast of North Korea' and to 'intercept and conduct surveillance of Soviet naval units operating in the Tsushima Straits.' The risk estimate was assessed as 'minimal'. A request for final approval was contained in the 'Monthly Reconnaissance Schedule for January 1968', maintained by the Joint Chiefs of Staff's Joint Reconnaissance Center (JRC). On 29 December 1967, approval was received from the proper agencies (JCS, CIA, NSA and the State Department) and from officials (Deputy Secretary of Defence Paul Nitze and the NSC's 303 Committee).



USS *Pueblo* caught by Article 131's Type 1 camera. (National Archives via Lin Xu)



In addition to its primary target, BX6847 also imaged several North Korean airfields. Note top of image how the taxiway disappears into a cliff-face and the MiG-17s on the apron. (National Archives via Lin Xu)



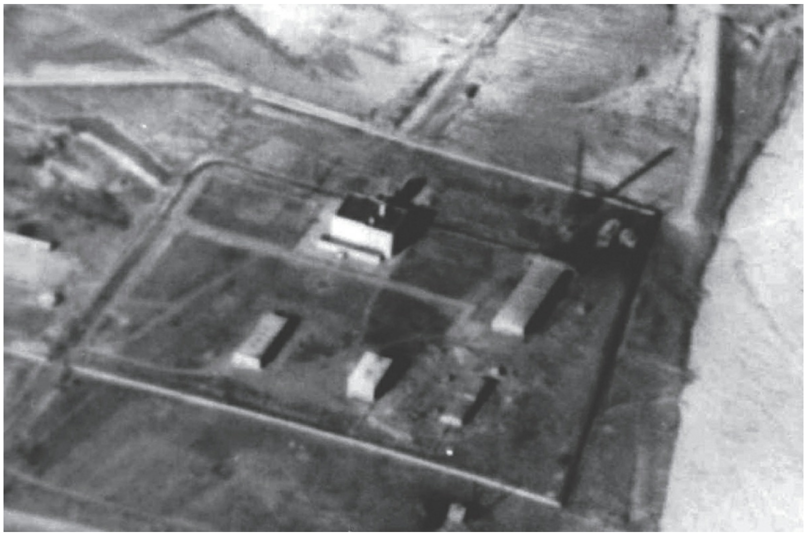
A more detailed look at the MiG-17s. (National Archives via Lin Xu)

On 5 January 1968, the unprotected *Pueblo* sailed as ordered on its maiden voyage for the east coast of a belligerent nation, North Korea. On board was a crew of six officers, two civilians and 75 enlisted men. Just 18 days later, during the night of 23 January, the ship's radio operator managed to get off an emergency signal. 'WE NEED HELP! WE ARE HOLDING EMERGENCY DESTRUCTION! WE NEED SUPPORT! SOS. SOS. SOS. PLEASE SEND ASSISTANCE! SOS. SOS. SOS. WE ARE BEING BOARDED!' The last sentence clearly stated what was happening aboard the beleaguered vessel, and with one sailor dead and the rest of the crew captured, a year-long nightmare for Lt Cdr Lloyd Bucher and his crew was just beginning.

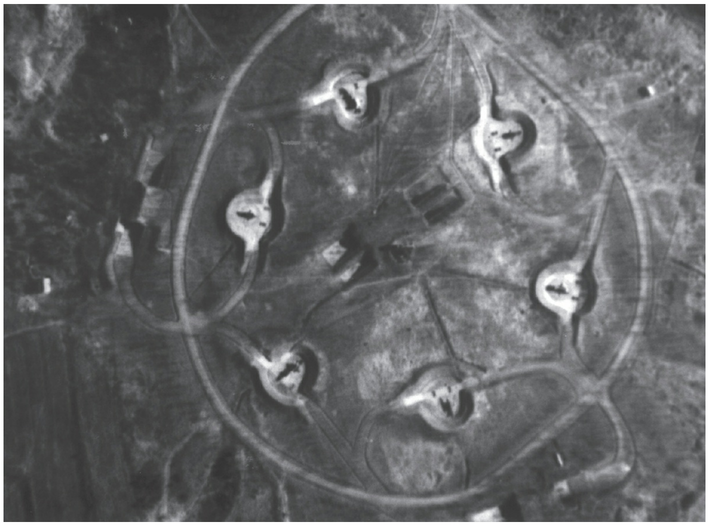
In response to the incident, President Johnson summoned his top advisors to a meeting at the White House the very next day (24 January) to agree a course of action. Later that day, DCI Richard Helms dispatched a top-secret memo to Special Assistant to the President Walt Rostow, Secretary of Defence Robert McNamara, Under Secretary of State Nicholas Katzenbach, Deputy Secretary of Defence Paul Nitze, and Chairman of the JCS Gen Earle Wheeler, in which he referred to the earlier meeting and confirmed that he was 'alerting an Oxcart mission for photo reconnaissance of North Korea'.

It continued:

> The Oxcart mission has been alerted to take off [deleted] on 25 January at 2100 EST (1100/26 January [deleted]) and return four and ½ hours later. The film will be off-loaded immediately and airlifted to Eastern Kodak, Rochester, New York, to arrive at approximately 0430 EST on 27 January. The processed film will be delivered immediately to NPIC with an arrival time of 1440 EST on 28 January.



Nearly 30 miles from BX6847's track, with a ground resolution of 2–3ft, is Yongbyon, North Korea's nuclear plant. (National Archives via Lin Xu)



Also recorded were 13 SAM sites, 12 of which were occupied. (National Archives via Lin Xu)

Point 3 in the memo noted: 'The weather forecast for this mission indicates Category II (25 per cent or less cloud cover) weather conditions for the target area.' Finally, point 4 noted: 'No additional resources or support over and above those normally used on Oxcart North Vietnam operational sorties will be required for this mission.'

On 26 January 1968, Jack Weeks completed BX6847 in Article 131 (see map). This three-loop, four-hour mission over North Korea remained in denied territory for just 15 minutes and was an enormous success, by any measure. Analysis of System 6 revealed that the majority of the air surveillance tracking was accomplished by Chinese radar facilities at Ma-t'a Point, Tungt'ai, Mu-yeh Island, Hai-yang Island, and Hunch'un. In addition, Soviet Bar Lock, Tall King, and Side Net radars, subordinate to Uglovoe, tracked 131 for five minutes. The Soviets broadcast one position plot of the aircraft at 02:32Z. There was, however, no indication of any North Korean surveillance tracking. Finally, there was no indication of a hostile weapons reaction, consequently no onboard DEF systems were activated.

This first mission photographed 82 North Korean and Chinese COMIREX targets and 837 bonus targets. In doing so, it established a comprehensive baseline coverage of most of North Korea's armed forces and industry, as well as large portions of the transportation system. The USS *Pueblo* and three new guided missile patrol boats (Komar PTG) were also observed on photography of this mission.

Just three days after Jack Week's highly successful mission, Lt Gen Joseph Carroll, Director of the NRO, fired off a memo to the Chairman of the Joint Chiefs of Staff, noting the following:

> 1. CINCPAC [Commander-in-Chief Pacific] and the Defence Intelligence Agency have conducted independent assessments of photography acquired by BX Mission 6847, flown over North Korea on 26 January. From these assessments, it has been determined that while much valuable photography and information were obtained, major deficiencies in our intelligence holdings still remain in the following target categories: a) Jet Capable Airfields: Current overhead photography is still required of seven major jet capable airfields in North Korea. Included is the important Il-28 bomber base at Uiju, which is the normal operating base for a majority of these aircraft. Of 80 Il-28s currently estimated in the North Korean inventory, only 12 were located by the 26 January mission. The seriousness of this coverage gap was further aggravated [text redacted – remains classified].
> b) Naval Order of Battle: Coverage was not acquired of the naval facility at Mayang Do, which normally serves the North Korean submarine fleet, nor was coverage of several key naval bases in north-eastern Korea. The requirement for current naval OB [order of battle] information was emphasized by the identification of three 'Komor'-class guided missile patrol boats on the recent BX mission. These boats, which were observed at Wonsan, increased our estimate of their holdings to seven. Coverage of the important naval bases in the northeast, therefore, is required to ensure our awareness of any important changes to North Korean naval OB in that area.
> c) Ground Force Activity: Additional high-resolution photography of the areas covered by the 26 January mission is essential to our continued military awareness of significant changes to ground force OB and related installations and activities. In addition, reconnaissance coverage of the North Korean border area adjacent China as well as most of the north eastern segment of North Korea is still required to establish a high-resolution database by which to measure military activities in these areas.
> 2. In order to satisfy the outstanding requirement outlined above, CINCPAC has specifically and

> urgently requested that an additional *Black Shield* mission be flown over North Korea. Based upon an assessment made within the Defence Intelligence Agency, I concur in the CINPAC position and recommend that the Joint Chiefs of Staff endorse this requirement and seek authority for additional *Black Shield* reconnaissance of North Korea.

However, US State Department officials were extremely wary of endorsing a second mission over North Korea after the *Pueblo* event. The diplomatic wounds left by the 1960 Powers incident were still sensitive eight years after the event. It was not until Brig Gen Paul Bacalis had briefed Secretary of State Dean Rusk on the specific mission objectives and assured him that the aircraft would only be in North Korean airspace for seven minutes (two passes, or 'photo lines') that the State Department gave its blessing.

Two flights were cancelled due to adverse weather conditions – BX6848 and 49, scheduled for 29 January and 9 February respectively. In addition, BX6850 slated for 14 February, was cancelled as the appropriate approval was denied.

On 16 February, Ken Collins completed BX6851, a two-looper of North Vietnam in Article 127. During a mission that lasted three hours 54 minutes, 13 minutes were spent over 'the North' whilst another four minutes were clocked up as 127 exited over part of Laos. The mission took place when there was little or no strike/jamming activity, and yet again, it was the Chinese radar facilities at Pei-li, Pei-hai, and Chiang-cheng that tracked the Oxcart. There was no indication of North Vietnamese radar tracking meaning that track information was probably obtained by them by monitoring Chinese broadcast facilities. There was no indication of a hostile weapons reaction, and no electronic defensive equipment was activated. To cap it off, unfortunately a rapid deterioration of weather over the target area resulted in little useable photography.

BX6852, scheduled for 16 February, was scrubbed due to the weather. However, BX6853, a two-pass mission over North Korea, was flown on 19 February 1968. Flying for a total of three hours 39 minutes, Frank Murray piloted Article 127 over North Korean airspace for nine minutes. Although on this occasion there was no indication of Soviet radars tracking the Oxcart, both Chinese and for the first time, North Korean Air Defense Systems were involved in tracking activities. The North Korean radar station at Maryong-San reported track and altitude information on Article127 from 04:58Z to 05:07Z during the second pass. Initial detection and final track ranges for the Maryong-San radar station were 54 and 237nm.

Frank Murray
"Dutch 20"
Area 51 - 1967

Frank Murray (stateside call sign Dutch 20) completed four Black Shield operational missions. (Lockheed Martin)

In all, 84 North Korean COMIREX targets plus 89 bonus targets were photographed. However, scattered clouds covered 20 per cent of the targeted area, concealing the position in which the USS *Pueblo* was photographed on mission BX6847. One new occupied SA-2 site was identified near Wonsan.

Yet again, the weather forced the cancellation of BX6854 and 55, scheduled for 27 February and 5 March respectively. However, a two-looper mission was flown by Mel Vojvodich back over North Vietnam in Article 127 on 8 March. Lasting in total four hours one minute, BX6856 spent 19 minutes over 'the North'. Penetration of enemy airspace was again made at a time when there was little or no strike/jamming activity and a change to the usual route penetration wrong-footed the enemy air defence system. As a consequence, only Chinese radar stations tracked the aircraft, and there was no apparent tracking of the vehicle, or indication or knowledge of the overflight by the North Vietnamese.

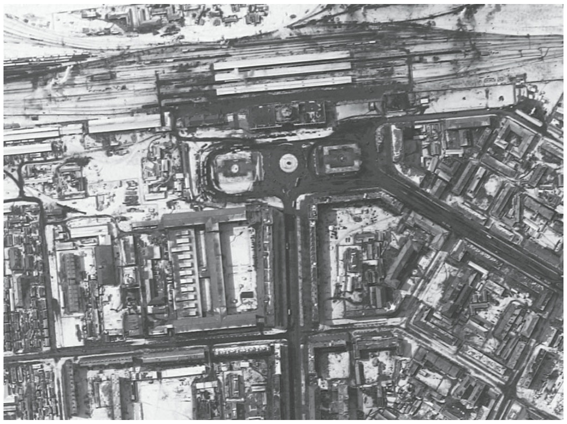
Good quality photography was obtained of Khe Sanh and the Laos, Cambodia, and South Vietnamese border areas. Unfortunately, no useable photography was obtained of North Vietnam due to adverse weather conditions.

Mission BX6857 planned for 27 April was scheduled to be the third sortie over North Korea, however the required approval wasn't forthcoming, so it was scrubbed. Eight days later, the necessary presidential approval arrived and BX6858 was executed by Jack Layton in Article 127 on 6 May 1968. Unknown to him at the time, his mission was the final operational flight of the entire Oxcart programme. The double pass spent just eight minutes in North Korean airspace and there was no indication of radar tracking by either the North Korean or Soviet ADSs. However, the Chinese radar station at Mata Point tracked 127 for 33 minutes on the first pass and 20 minutes on the second, but there was no indication of a hostile weapons reaction.

However, Layton did experience a moment of tension during the high-speed cruise back to Kadena when 'milky white fingers' began slowly clawing their way across the windscreen. Having experienced this 'white-out' phenomenon to a lesser degree during an earlier stateside training sortie, Jack was aware of the problem, which was caused by frictional heating on the windscreen to the point where the glue between the glass laminations became viscous and turned completely opaque. Proceeding on instruments all the way to landing, Jack completed a successful ground-directed radar approach for a safe recovery back to 'home plate', after three hours 30 minutes in the air.

Unfortunately, due to cloud cover and heavy haze, interpretability of mission photography was severely hampered. Despite this, 68 COMIREX targets plus 30 bonus targets were photographed, of which 15 were SA-2 sites – three of which were occupied and one unoccupied, 11 more were designated 'identified only'. Also discovered was a SAMLET, a coastal defence cruise missile site, tentatively identified on the east coast between Wonsan and Ham hung, but weather conditions in the target area did not permit the photographing of USS *Pueblo*.

Although the procurement of such intelligence information was not of direct benefit to Lt Cdr Bucher and his crew, who endured beatings and were held captive for almost a year, such a 'hot-spot, quick-look' capability was considered an important achievement of the Oxcart programme, clearly demonstrating the ability of manned reconnaissance vehicles to respond with minimal lead times to international incidents of political and military importance. The *Pueblo* incident signalled the end of the US Navy's seaborne foray into ELINT trawling, the two remaining AGERs being scrapped soon after the vessel's seizure.



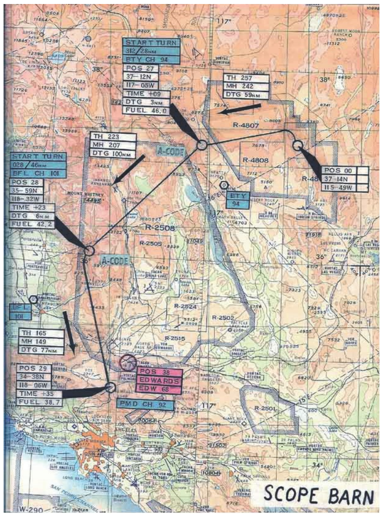
Pyongyang Railroad station imaged during BX6853. (National Archives via Lin Xu)

U.S. AIR FORCE

Article 129, AF serial 60-6932, completed five Black Shield missions. The A-12 and its pilot Jack Weeks were lost in an accident on 5 June 1968 after Oxcart had been terminated. No trace was ever found of either pilot or aircraft. (Lockheed Martin)

ALOHA !
"HARD WAY KEN"
CONGRATULATIONS ON
YOUR NEW INTER-ISLAND
SPEED RECORD 124 HRS. 22 MIN.
AVERAGE SPEED 36.2/10 MPH (.061 MACH)

Ken Collins finally made it to Hawaii after innumerable attempts to launch from Wake Island. He was attempting to ferry an A-12 back to Area 51 in 1968 following termination of the Oxcart programme. (via Ken Collins)


SCOPE BARN
START TURN
A-CODE
R-4807
R-4808
R-2508
POS 30
EDWARDS

Scope Barn; this is a copy of the actual chart used by Frank Murray to position the last remaining A-12 from Area 51 to Lockheed's Palmdale facility following programme shutdown. (CIA via Roadrunners Internationale)

Since completing Operation Black Shield's first mission 340 days earlier, and having established definitively that there were no Surface-to-Surface Ballistic missiles in North Vietnam, it is interesting to note how the task shifted increasingly away from gathering strategic reconnaissance and more towards harvesting nonetheless still vital reconnaissance used to support tactical operations. This phenomenon, well-known to military commanders as ‘mission creep’ was, it’s probably true to say, something never envisaged by Eisenhower or Oxcart’s operators or the CIA and as such, this newly ‘acquired’ mission fell well outside the Agency’s modus operandi.

OXCART CLOSEDOWN

It is ironic that during the very month Oxcart was finally declared operational (November 1965), and before the programme had had the opportunity of fully vindicating itself, moves were afoot to close it down. It was during that month that a memorandum was circulated within the Bureau of Budget (BoB) expressing serious concerns at the costs of Oxcart and Senior Crown (the SR-71 programme).

The memo challenged the need for the number of high-performance aircraft and doubted the necessity for separate ‘covert’ CIA and ‘overt’ USAF operations. Its writer proposed several less costly alternatives, recommending that the A-12s be phased out by September 1966 and that all further procurement of SR-71s should stop. Copies of the memo were circulated in certain circles within the DoD and CIA, together with a suggestion that they explore the alternatives set out in the paper. Since the SR-71 was not scheduled to become operational until September 1966, SecDef McNamara declined the proposal.

In July 1966, BoB officials proposed that a tri-agency study group be set up to establish ways of reducing the costs of the two programmes. In addition to budgetary considerations and politics, differing capabilities between the A-12 and SR-71 further complicated the decision-making process. The A-12 was lighter and therefore could fly higher than its Air Force stablemate. Additionally, its cameras provided superior ground resolution to those being carried by the SR-71. However, the Air Force countered that in addition to carrying cameras, its platform mounted sensor packages, enabling it to undertake simultaneous synoptic coverage of a target area by recording ELINT and, using its powerful ground mapping radar system, radar intelligence (RADINT).

In an attempt to resolve the dichotomy, a fly-off, codenamed Nice Girl, was staged between the two types over the period 20 October to 3 November 1967. An example of each flew three identical routes along the Mississippi River. Representatives from a number of interested agencies then evaluated the data collected, but the results were inconclusive. With the study complete, a meeting was convened on 12 December 1966, and a vote taken on each of the three alternatives that had been proposed:

Oxcarts awaiting storage on arrival at Palmdale in 1969. (Lockheed Martin via Tony Landis)

1) To maintain the status quo and continue both fleets at current approval levels;
2) To mothball all A-12 aircraft, but maintain the Oxcart capability by sharing the SR-71 between SAC and the CIA;
3) To terminate the Oxcart fleet in January 1968 (assuming an operational readiness date of September 1967 for the SR-71) and assign all missions to the Air Force SR-71 fleet.

Three out of four votes cast were in favour of option three. The BoB's memorandum was transmitted to President Johnson on 16 December, despite protestations from the CIA's Richard Helms, who was the sole dissenting voice in the vote. Twelve days later, Johnson accepted the BoB's recommendations and directed that the Oxcart programme be terminated by 1 January 1968.

However, as the war in Vietnam escalated and the results of Black Shield's outstanding work were made available to a privileged few, the wisdom of the phase-out decision was called into question. As a result, the run-down lagged and the debate re-opened. A new feasibility and cost study of Oxcart was completed in the spring of 1968, and despite the continuing objections raised by Richard Helms, the original decision to terminate the programme was reaffirmed on 16 May 1968 by the Secretary of Defence; the decision was further endorsed by President Johnson five days later, during his weekly luncheon with his principal advisors.

Project officials decided that 8 June 1968 would be the earliest date to begin the redeployment from Kadena back to the States. During the intervening period, sorties would be restricted to those essential for maintaining flight safety and pilot proficiency. Those aircraft back at Area 51 were to be flown to Palmdale and placed in storage by 7 June. Meanwhile, at Kadena preparations were made for the A-12 ferry flights back to the United States. Mission sensors were removed for the final time and low-time/high-performance engines replaced with less highly tuned units; FCFs were flown to confirm each aircraft's readiness for its transpacific flight.

During an FCF on 2 June 1968, Frank Murray got airborne and headed south of Okinawa well away from unfriendly land-based radars. The well-worn test and training route was tear-drop shaped, pointing toward the Philippines, where a long, shallow, 190° turn was initiated back towards Kadena. This high and fast cruise leg continued over the base and was followed by a tighter let-down tear-drop pattern, which brought the aircraft in towards final approach.

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Eight A-12s and the remaining M-21 were placed in long term storage inside a hangar at Palmdale. Note the bogus serial number in red applied to Article 131, AF serial 60-6937, during Black Shield. (Lockheed Martin)

After taking fuel from a tanker, Frank flew the full route, but recalled that the right engine would not go into bypass until it reached Mach 3, as opposed to the normal speed of Mach 2.6. The flight continued without further incident until Article 129 passed over Kadena, where Frank began his deceleration and descent. At that point, he discovered the right engine would not come out of bypass. As deceleration continued, the inevitable happened. Since the bypass system continued to deliver most of the air to the afterburner section and very little to the combustion section, the engine flamed out. Once '129 was subsonic, Frank restarted the engine and recovered into Kadena without further incident. It was obvious that the right engine would have to be changed to solve the problem.

On 4 June, Jack Weeks left Kadena in '129, with the intention of finishing the FCF; he completed a 34,000lb fuel on-load from the tanker, accelerated and climbed away. That was the last anyone saw of pilot or aircraft. Forty-two minutes into the flight, the Birdwatcher at Kadena received a signal from channel 54, indicating that starboard engine EGT was in excess of 860°. Twenty-two seconds later, Birdwatcher repeated the signal, while a transmission from channel 7 indicated that fuel flow to the same engine was less than 7,500lb/hour. Eight seconds on and a third and final Birdwatcher transmission was received. It repeated the earlier information from channels 54 and 7, but this time included a signal from channel 3, ominously indicating that the aircraft was at or below 68,500ft.

From this limited evidence, it is reasonable to conclude that a malfunction involving an over-temperature and low fuel flow to the right engine contributed to what appears to have been a catastrophic failure and subsequent aircraft break-up. Not a trace of wreckage was found and it is particularly ironic that such a highly competent and professional pilot should have been lost on one of the very last flights of the Oxcart programme.

The two remaining A-12s on Okinawa (Articles 127 and 131) were to be ferried back to Area 51 before being positioned to Palmdale. On 7 June 1968, Frank Murray boarded 131 for the flight back to the US. He topped off his tanks near Iwo Jima and then flew a 'hot leg' to Wake Island, where he decelerated for another refuelling. Before 'plugging in', he noticed a high rate of fuel flow on the right engine. Through the small rear-view periscope, he saw that the right engine was leaving a trail of unburnt fuel behind the aircraft. He told the tanker crew he had a fuel leak and that he would have to dump much of the remaining JP-7 before landing at Wake Island.

After the recovery team arrived, the afterburner (A/B) fuel line was replaced and the aircraft flight-tested. Next, Ken Collins flew '131 at subsonic speed into Hawaii's Hickam AFB for a full service prior to the final leg home. It was found that the airframe-mounted gearbox was out of alignment and vibrating so badly that it caused fuel lines to break. From Hickam, it took Frank Murray three more attempts before he was able to coax the reluctant A-12 back to the 'Ranch'.

Meanwhile, Denny Sullivan had flown the last Oxcart aircraft back from Kadena to Nevada on 9 June, in just five hours 29 minutes.

After it was all over, Maj Bill Wuest, Area 51's poetic weather officer named the 'Bard of Beatty' after a small town just outside the area, penned the following rhyming couplets in honour of those two 'record-breaking' return trips.

The five (suited) A-12 pilots to have flown Black Shield missions are awarded the CIA Star for Valor. Left to right: just in shot, Mele Vojvodich; Dennis Sullivan; Admiral Rufus Taylor, Deputy Director CIA; Jack Layton; Ken Collins; and Frank Murray. (CIA via Roadrunner Internationale)

CENTRAL INTELLIGENCE AGENCY
FOR VALOR

The coveted CIA Intelligence Star for Valor. (via Dennis Sullivan)

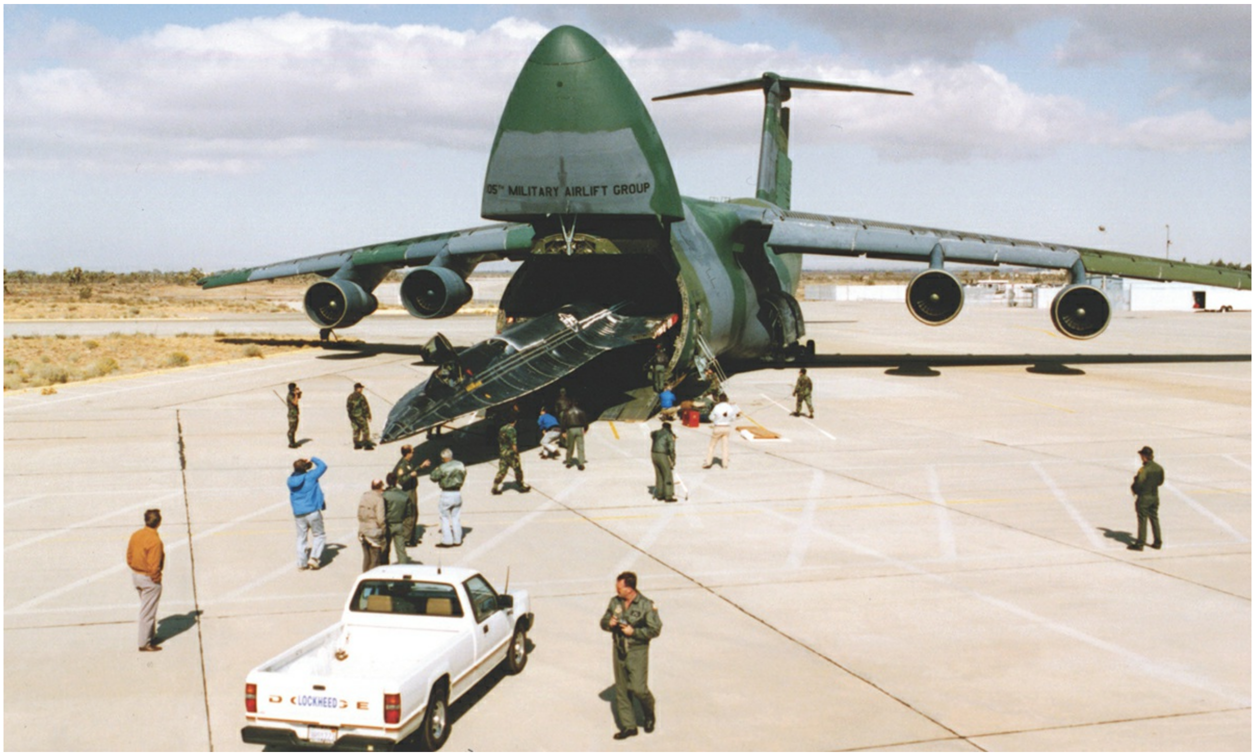
Congratulations from the Bard of Beatty – 19 June 1968
When Denny rushed across the Pond in Five-plus-Twenty-Nine,
All hopes had sunk for Ken and Frank to break the record time.
But nothing daunted, that slow pair conspired to save the day.
With greatest skill and cunning broke a record anyway.
Eleven days it took them both to make that ocean trip.
The slowest 'Record', high-speed flight was now within their grip!
That Record time they'll surely keep until the final day.
For Beale's crews will never want to take their TIME away!

The final A-12 flight took place on 21 June 1968, when the last Cygnus, Article 131, was ferried from the 'Ranch' to Palmdale by Frank Murray. At the

Lockheed plant, company maintenance technicians drained all its fuel and hydraulic lines, while employee Mel Rushing skilfully ‘interwove’ all nine remaining Oxcart aircraft into a tightly regimented, sardine-like parking array in a corner of one of the large hangars, where they remained for more than 20 years, before being dispersed to museums.

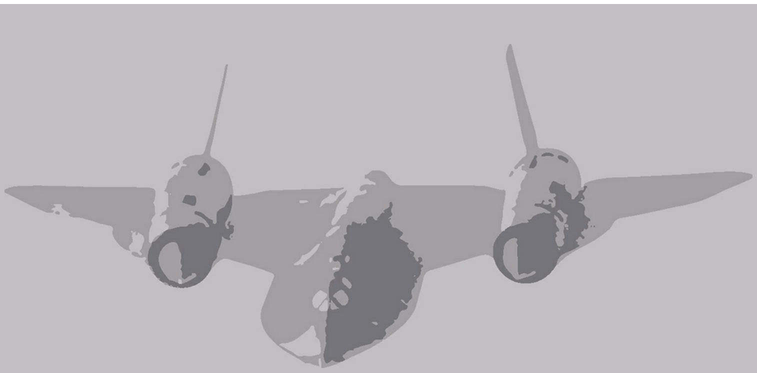
On 26 June 1968, Deputy Director of the CIA Vice Admiral Rufus Taylor presided over a ceremony at Area 51 where he presented the CIA Intelligence Star for Valor to Ken Collins, Jack Layton, Frank Murray, Denny Sullivan and Mele Vojvodich for their participation in *Black Shield;* the posthumous award to Jack Weeks was accepted by his widow. The Legion of Merit was presented to Col Slip Slater and his deputy, Col Amundson. In addition, the Air Force Outstanding Unit Award was presented to members of the Oxcart Detachment, the 1129th Special Activities Squadron, also known as ‘The Road Runners’, after the speedy ground cuckoo indigenous to Mexico and the southwestern United States.

The long-standing debate concerning whether Oxcart or Senior Crown should carry forward the tri-sonic, strategic reconnaissance baton had been resolved after three years and the former was vanquished. In early March 1968, SR-71s began arriving at Kadena to take over what had been the *Black Shield* commitment.

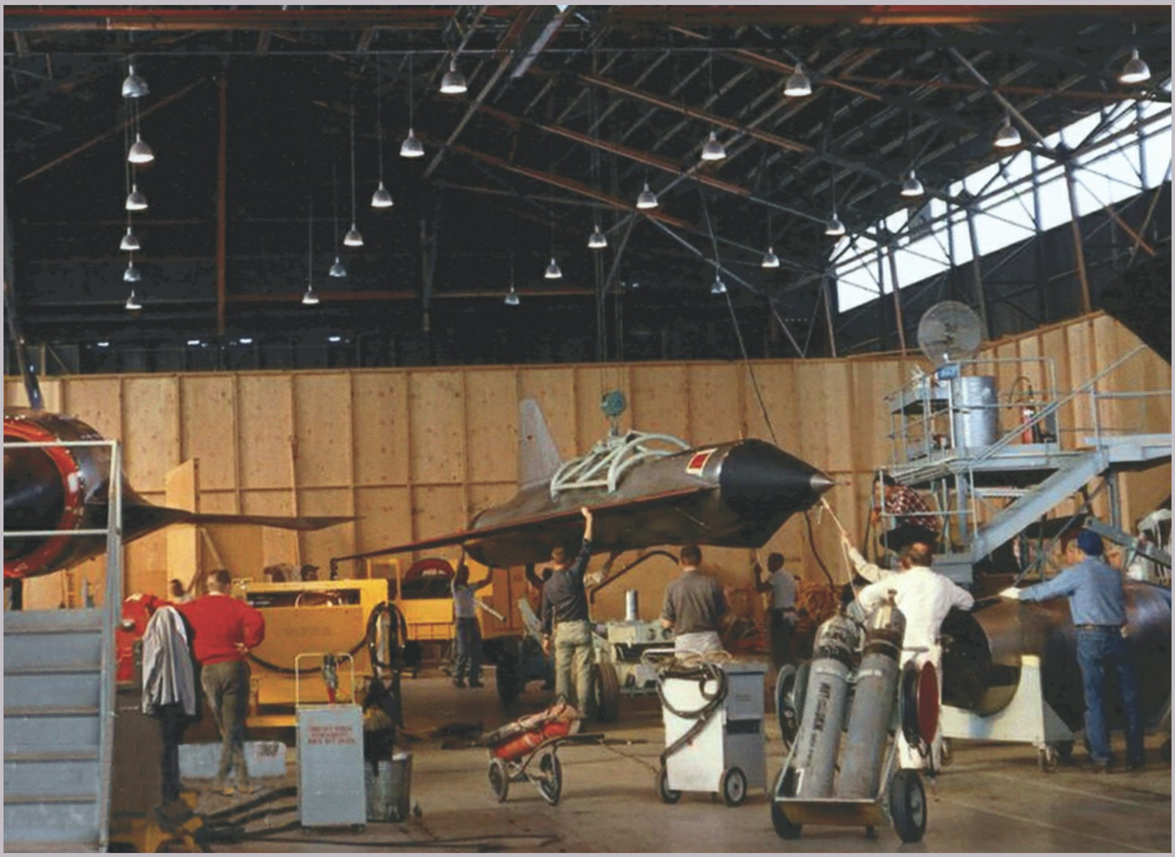


105TH MILITARY AIRLIFT GROUP
LOCKHEED

When Oxcart was finally declassified A-12 Article 128, AF serial 60-6931, was flown by two C-5s to the Minnesota Air National Guard Museum before being moved to its current location – CIA headquarters at Langley, Virginia. (Tony Landis)



CHAPTER 7:
TAGBOARD AND SENIOR BOWL



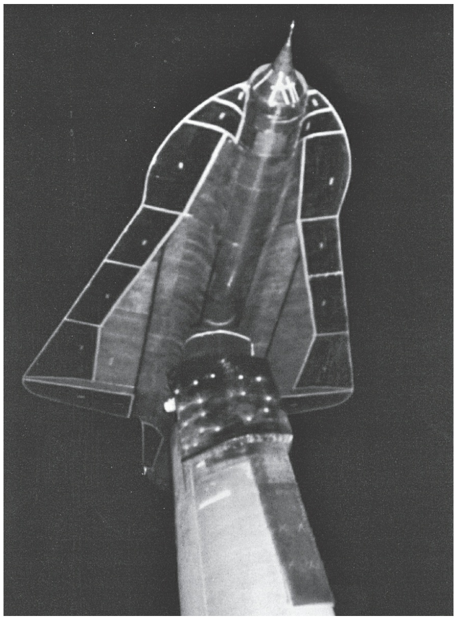
D-21 drone 501 about to be craned slowly onto its mounting pylon on the back of M-21 134. There was a mere 6in. of clearance between the drone's wingtips and the M-21's twin tails. (Lockheed Martin via Tony Landis)

In the political fall-out from the U-2/Frank Powers shootdown, a meeting between Kelly Johnson and Dr Eugene Fubini, of the Office of Defense and Engineering, took place at the Pentagon early in 1962. Kelly was asked if it would be possible to develop a small-scale version of the A-12 that could be droned, carry a reasonable reconnaissance payload and possess similar performance characteristics to that anticipated for the Oxcart. Fubini believed that were such a parallel development possible, it would afford the president a choice between a manned or unmanned platform from which to conduct 'reconnaissance of critical denied areas'.

Perhaps not surprisingly, Kelly responded enthusiastically, believing that such a machine was entirely feasible and that its development timescale would be compatible with that of the full-scale platform; he further suggested that the drone could be launched from a modified Oxcart vehicle. As a consequence, the Skunk Works were authorized to perform a six-month drone configuration and feasibility study.

In a memo to Secretary of Defense McNamara, dated 26 September 1962, Dr Joseph Charyk, Director of the NRO, noted that the drone programme, now known as Project Tagboard, '…appears to offer an alternative means to the A-12 and satellite systems for the purpose of overflight photography, but it seems to me that the drone would provide no better overflight capability than the A-12 will provide and, from my assessment, the political considerations in sending a drone on this type of mission are not significantly different from the political considerations in manned overflight.' He did, however, recognize that a scaled-down version of the A-12 would result in a vehicle with an equally reduced RCS, making the enemy's task of tracking it during clandestine overflight operations more difficult.

During a meeting between McNamara and DCI Allen Dulles on 5 October, it was agreed to proceed with the initial stages of Tagboard. However, in view of the system's technical uncertainties, it was further agreed that the programme would be carefully reviewed after the initial study and feasibility phase had been completed. A subsequent meeting between Dr Charyk and Dr Herbert Scoville, CIA Deputy Director (Research), determined that management responsibility for the project should, as in the case of Oxcart, sit with the CIA, and that the DoD should assign an individual to the Agency who was both 'knowledgeable and enthusiastic' for the programme.



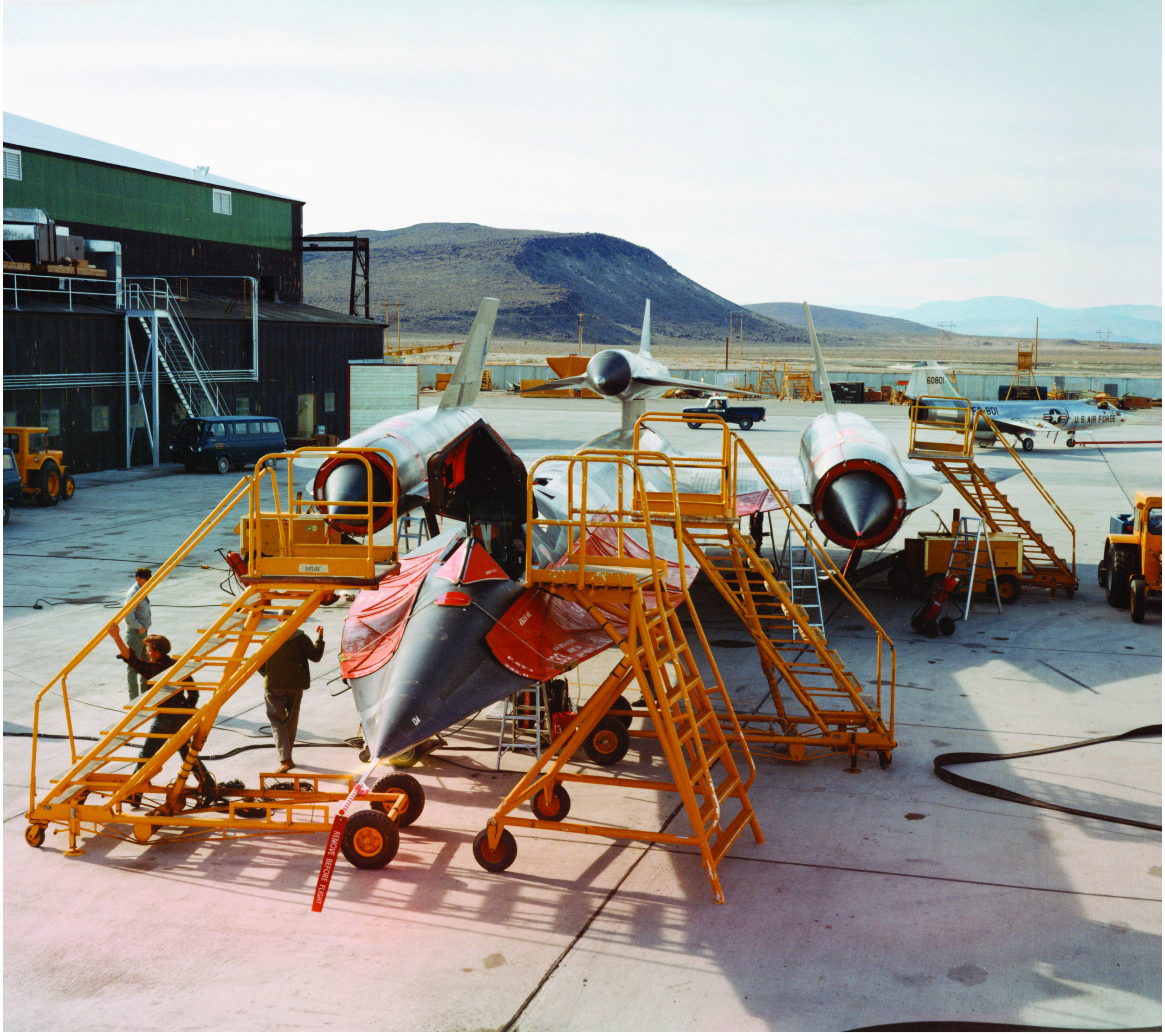
The characteristic double-delta planform of the D-21 is evident during RCS tests on the Area 51 RatScat range. (Lockheed Martin via Tony Landis)

On 9 October 1962, Kelly provided a written proposal of the feasibility study to the Assistant Director OSA, which included a completion date for the work of 2 January 1963. In a memo to Herb Scoville dated 17 October 1962, Dr Charyk stated: ‘NRO management responsibility for this development is assigned to the Director, Program B (AD/OSD)’ and that he, Dr Charyk, ‘was prepared to assign Lt Col Henry Howard from the NRO Staff to the Director, Program B, for this important task.’ (In a classified memo to the DCI from Herb Scoville dated 12 June 1963, the latter noted that ‘nothing further was heard from the NRO Staff on Colonel Howard’s nomination to this Agency’ – an indication of the friction that had developed between the NRO and the CIA at this time). Nine days later, Scoville responded to Charyk’s memo and confirmed that ‘Colonel Jack C. Ledford, USAF, Director, Program B, has assumed managerial responsibility for the AQ-12 drone project.’

On 5 November 1962 Kelly wrote in his diary: ‘The drone is developing without much discussion between Headquarters and ourselves. I think I know what they want, but no one has spelled it out. We will try to get 6in. ground resolution photography, a range of 3,000nm, and a payload of 425lb for the camera. We will attempt to save the expensive elements of the aircraft by parachute recovery of the nose.’

While Lockheed continued with the feasibility study, the OSA was busy soliciting camera proposals for the AQ-12 drone from likely manufacturers. On 3 December 1962, firm proposals were received from Eastman Kodak, Perkin-Elmer, ITEK Corporation and the Hycon Manufacturing Company (Hycon was Kelly's preferred option and later won the contract to build one prototype and nine production cameras).

Both Charyk's and Scoville's respective departments closely analysed Kelly's feasibility studies and recommended that the development of Tagboard should proceed, a decision further endorsed by both the SecDef and DCI during a subsequent meeting. Consequently, on 28 February 1963 Lockheed was given the go-ahead for the procurement of 20 drones. In addition, modifications were to be made to two A-12s into drone launch configuration (the A-12 conversion programme was referred to as Wedlock in a later classified document written by John Parangosky, who at the time of writing was the CIA's Deputy Director of Special Activities). These proposals were later confirmed in an official letter from the CIA dated 20 March 1963.



Tagboard is made ready for the first mated flight. Note the camera mounted on the right cockpit rail to monitor flight instrumentation and the F-104A-20-LO chase aircraft 56-0801 in the background. (Lockheed Martin)

Meanwhile, there was ill feeling between the CIA's Herb Scoville and the NRO's newly appointed director, Dr Brockway McMillan, as the latter attempted to wrestle control of Tagboard away from the CIA and over to the USAF. On 4 June 1963, McMillan signed a memo to Scoville and the Director of Program D assigning responsibility for conducting Project Tagboard to Colonel Leo Geary, USAF, Director of Program D (a post later held by Col Saunders).

Earlier that year, Bob Murphy received a telephone call from his boss Robert

Pouc, who informed him that he intended to promote 'Murph' to superintendent. Lockheed was carrying out modifications to Air Force U-2s that would enable them to use the more powerful J75 engine, and 'Murph' was to head up the programme. Delighted by the news, he soon received another phone call, this time from Kelly's secretary requesting his presence. Kelly said, 'Murph, I'm going to promote you to superintendent,' to which Bob replied, 'Yes, I know.' 'How do you know? I've only just told you.' It was his second promotion that day!

But what Kelly had in mind was something radically different from Murph's earlier promotion. The ADP boss showed his newest superintendent some sketches of an altogether strange-looking beast designated the D-21. Johnson instructed Murph to 'find a building for housing the necessary engineering and build them.'

Initially the Lockheed programme manager for Tagboard was Rus Daniell, but when he became involved in the development of the RS-12, responsibility for the D-21 became the purview of Art Bradley. The launch platforms were A-12 Article numbers 134 and 135, 60-6940 and 60-6941, respectively. To reduce the possibility of Skunk Works personnel confusing the A-12 with the drone-carrying variant in documentation or security issues, it was re-designated M-21 (the M standing for 'Mother'), and the two digits were also intentionally reversed. With construction under way in Building 309/310 at Burbank, a fit check – using M-21 134 and D-21 501– was completed successfully on 19 June 1964 inside the manufacturing plant. On 12 August 1964, the M-21 prototype, Article 134, was trucked to Area 51 to undergo initial post-modification flight testing.

Built primarily from titanium, the D-21 had a frontal area RCS of just 0.2m^2 from a 15° depression angle; it had a range of 1,250nm, cruised at Mach 3.3, possessed an end-of-cruise altitude capability of 90,000ft and was powered by a single Marquardt XRJ-43-MA20S-4 ramjet. The drone burned PF-1 fuel, the same as that used to power the M-21's twin J58 engines.

The drone was carried on a pylon and launched from the M-21 by a Launch Control Operator (LCO) located in what was the A-12's Q-bay; the drone then flew its sortie completely independently. The mission was accomplished by the D-21's pre-programmed INS, into which had been loaded the desired track, flight profile, camera on and off points, and bank angles, allowing it to satisfactorily execute the perfect photo-recce sortie.

The CIA's Committee on Imagery Requirements and Exploitation (COMIREX) controlled the classification of film for Tagboard, Oxcart and other black world reconnaissance projects, and for this programme each mission would be classified Top Secret, the handling caveat being 'NO FOREIGN DISSEMINATION', and to further protect the platform's security code word (Tagboard), each frame was allocated the non-aligned code of 'Chess'.

Having completed its camera run, the drone's INS sent signals to the autopilot system to descend the vehicle to a pre-programmed 'feet wet' film collection point. At the appropriate position and altitude, a palletized panel containing the INS and camera unit was ejected and allowed to parachute towards the ground. As the drone continued its descent, it would be blown apart by a barometrically activated explosive charge. The drone's INS and the HR-335 camera containing its valuable film would then be retrieved by a Lockheed JC-130B Hercules equipped with a Mid-Air Retrieval System (MARS), then flown to a base where the film would be extracted and sent for processing and analysis.

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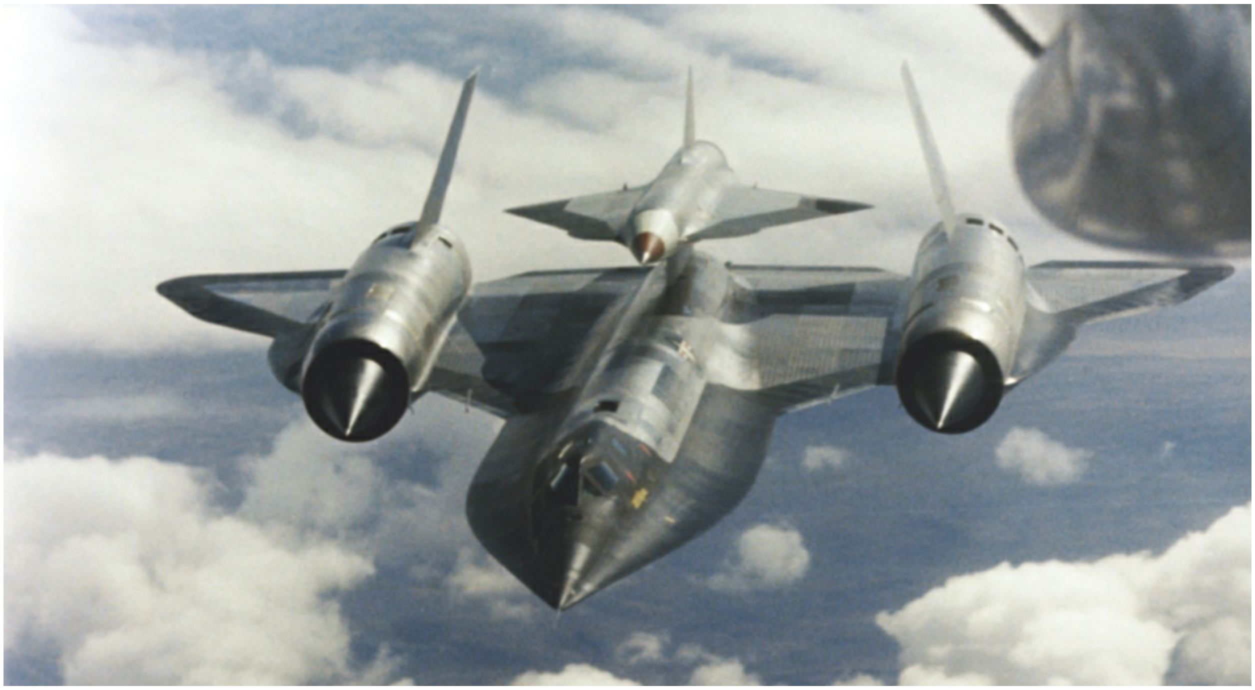
Bill Park flew all the mated M-21/D-21 flights, the first of which occurred during the late afternoon of 22 December 1964. (Lockheed Martin)

During the early development stages of the D-21, tests were conducted at

Area 51 using a JC-130 to validate recovery techniques of the reconnaissance pallet. The pallets were airdropped from a B-66 flying at maximum altitude, and the C-130 took up a racetrack holding pattern in readiness to catch them. It was deemed necessary to document these events on film, so a photo chase platform capable of flying in formation with the JC-130 at about 24,000ft had to be identified.

Neither the Area's F-101s nor the T-33s used as currency trainers and 'hacks' were up to the task, and since the C-130 would be flying with its flaps down, the U-3B was also unsuitable. As instructor pilot (IP) for the Cessna 210, Frank Murray volunteered to attempt to take it up to 24,000ft to see if it was capable of performing the job, as he now explains.

> I loaded our trusty Lockheed movie photographer on board and took off to see… bearing in mind that the 210 had the most rudimentary oxygen system, just a plastic mask of sorts and a small oxygen cylinder. The Cessna's handbook indicated that flight at 24,000ft was possible and I managed to get it up to that altitude and about 125kt, thanks to the turbocharger. We returned to base with the good news and were scheduled on the next MARS mission.
>
> I took off first, rendezvoused with the C-130 and the game was on. The 'Herky-bird' acquired the radar beacon on the pallet when the 'chute was deployed on descent; it flew a race track pattern over the intended drop zone, and I followed a bit higher, so that I could manoeuvre into position and dive off a bit of altitude if I needed to be in position for the pallet pick-up.
>
> It was planned that the MARS C-130 would make repeated passes at the descending pallet's 'chute until he either caught it or had to quit trying due to getting too low. If I remember correctly, the first attempt did not result in a catch, so the pallet let down all the way to the lakebed, north of the Area, in the vicinity of the A-12 refuelling track in the SOA. So we flew home without much except for some pictures of him trying to capture the thing. Interesting flying really, but then I had all kinds of interesting flying in my five years at the Area and elsewhere.
>
> Another MARS sortie was scheduled shortly afterwards and off we went again. The tactics of the first mission had worked, so nothing was changed in either my plan or theirs. After a while the C-130 reported that he had contact with the beacon, so he adjusted his pattern to suit the catch. As usual, I'm behind and a little higher than him. Soon we both see the pallet and shout, and he heads in. I'm slightly out of position and behind him, so I let down towards him in a turn calculated to cut him off and be in a position for filming. But at about this time I fly through his turbulent wake path and the poor little 210 gets tossed around like a rag doll. At one point I saw the big 24v battery that powered the movie camera right next to my head, it had been sitting on the floor at the back of the 210; luckily it came to rest on the seat in the back and we just barely got our pictures – the MARS was also successful this time.



The D-21 LCO could top up the drone's fuel tanks by transferring fuel from the M-21. (Lockheed Martin)

The maiden flight of Tagboard took place at Area 51 on 22 December 1964. Take-off time slipped because of delays brought about by the late arrival of senior Lockheed executives, who had attended the maiden flight of the SR-71 down at Palmdale earlier that day. Despite its early, lower-powered J58 engines, Park was still able to take Tagboard supersonic.

Keith Beswick was a Lockheed flight test engineer assigned to the Oxcart programme at Area 51. He initially worked with other engineers on Article 121 before becoming lead engineer on 123, 124 (the pilot trainer), and 129 (the electronic inlet control test-bed aircraft). He then transferred over as lead engineer to Articles 134 and 135 on Project Tagboard, flew several flight test sorties as launch control operator (LCO) with Lockheed test pilot Bill Park, and recalls:

> With the D-21 in place, it generated considerable drag, which created difficulties for the M-21, particularly during the transonic phase of flight. To begin with it resulted in an exponential fuel burn. So once airborne from Area 51, the first order of business for the 'MD-21' (and incidentally most of the A-12s used the same procedure to reduce take-off weight) was to rendezvous with the KC-135Q tanker and top off the tanks.
>
> Once topped off, according to Ben Rich and Dick Fuller, we should accelerate to 250kt and then hold that speed and we'd be able to accelerate through Mach 1 'in no time at all'. But in reality it wasn't as straightforward as that. We attempted this a few times and we'd get out to 0.97 Mach, but

just couldn't accelerate any further, meanwhile our fuel burn went through the roof! Back in Burbank at the Skunk Works, Bob Biffle, one of our flight test analysts, had been running some numbers and came up with a possible solution to our problem.

One of two frame grabs from the M-21's high-speed cameras, mounted in pods between the M-21's fuselage and engine nacelles, catch the moment the drone separates from its pylon at Mach 3.12. (CIA via Toni Hiley)

This second frame grab captures the momentary ignition of the D-21' s rocket motor. (CIA via Toni Hiley)

He suggested after accelerating to 0.90 Mach, we start a 0.9 Mach climb and hold it until our rate of climb had decayed to 200 or 300ft/min and then push over into a fairly steep dive, so we gave it a try. Once we reached about 42,000ft the climb rate had washed away. Bill [Park] eased the nose down into a descent of 30–40°, the Mach built up and he pulled out at about 29,00ft and 1.17 Mach, and we were able to continue the climb and acceleration with a much-reduced fuel burn. A few flights later, we found that once we were above Mach 1.2, we could start the D-21's ramjet engine and this would augment available thrust.

By May 1965, Kelly noted in his log, 'We are ready to light the engine of the drone, but we must get a new course to run as we cannot accelerate sufficiently in a turn. We are being restricted by a lack of suitable test areas.' On 21 October, Kelly noted, 'We have had great difficulties getting Tagboard out to speed and range. We tried to run to Point Mugu for launch practice, but couldn't make the range. Transonic acceleration is very poor, particularly with high air temperatures. As of this day, we are putting in 34,000lb thrust engines. Have had to convert from the Hamilton Standard inlet control to our own, and are having trouble blowing the nose cone [the ceramic nose cone cover over the D-21's inlet] and keeping parts out of the inlet.'

Keith Beswick remembers:

> As the programme progressed it became time to practise D-21 launch procedures. For this we'd refuel the M-21 and D-21 from a KC-135Q in an AR track about 50nm north of the test site. With full tanks we then routed northeast over to Mountain Home AFB, Idaho, and then turned and continued towards Dalhart, Texas, where we would rendezvous with another tanker, top off and then head directly towards Point Mugu NAS, California. During this leg, about 150 miles east of Point Mugu we'd reach Mach 3.2 and 80,000ft.
>
> The procedure then called for Bill to lower the nose to get 0.9G, which should enhance drone separation. On one of these practice manoeuvres, as we nosed over, both inlets unstarted. Bill conducted a quick instrument panel scan, but we knew it was pointless trying to get the engines started until we got down into more dense air, below 50,000ft. Passing through 50,000ft Bill attempted the restart … no luck. The aircraft remained very stable and he tried another restart at 40,000ft, still nothing. He attempted yet another at 35,000ft, and still the engines refused to start. By this time we were about 100 miles west of Point Mugu over the ocean. So Bill said to me, 'Well, what do you think we should do.' So I said, 'Well I don't know, it's your airplane that's in trouble.' Bill replied, 'Yeah, but you're in my airplane *too* and if we don't get this thing relit by 18,000ft I'll be leaving, so it will be your airplane.' I should say that our conversation was very calm, and the guys commented on this fact when they played the cockpit voice recorder back at base.
>
> The fact is that I'd flown with Bill on many occasions and I still think he was the most professional, unflappable pilot I've ever flown with. So anyway, we're now approaching 25,000ft and Bill said, 'Any ideas?' I responded, 'Well, I guess there's always the checklist.' So I began reading through it. 'Inlet spikes forward?' 'Yeah, the spikes are forward.' 'Forward bypass doors open?' 'Yeah, they're open.' 'Aft bypass doors closed?' '…' Then there was a click, click (which was the aft bypass doors closing) and almost immediately both engines restarted! The problem was that we'd left the aft bypass doors open (which is the normal Mach 3.2 configuration) after the inlets unstarted. We recovered without further incident and returned to the test site. During the post-flight debrief, one of the Air Force sergeants asked, 'with the D-21 on your back, and both of your engines out, how did the airplane glide?' Bill replied, 'About like a manhole cover!' Flying with Bill Park was always a privilege and a pleasure.

Bill Park piloted all the M-21/D-21 mated sorties. The monumental problems concerning platform and systems integration that Tagboard had to overcome cannot be overstated, but by 1966 the programme had progressed to the point where vehicle separation was to be performed.

The mission profile during this critical stage called for Bill to fly the aircraft at Mach 3.12 and commence a slight pull up at 72,000ft, then push over to maintain a steady 0.9G on the highly sensitive G-meter fitted in the M-21. With controllability checks on the D-21 completed and its ramjet ‘burning’, Keith Beswick initiated vehicle separation.

Park and Beswick achieved the first successful vehicle separation on 5 March 1966, but drone number 503 was lost just 120 miles from the launch point. A second launch was completed by Park and LCO Ray Torrick on 27 April, with drone 506 adhering to its preprogrammed course to within half a mile during a flight of 1,200nm. It reached an altitude of 90,000ft and Mach 3.3 before finally falling out of the sky and into the Pacific Ocean after a hydraulic pump burned out, the whole flight having been followed from the ground by Kelly, who had flown into Point Mugu for the event.

A second batch of D-21s was ordered on 29 April 1966, and the following month Kelly made a formal proposal to SAC to launch the new drone from Boeing B-52Hs, on the basis of greater safety, lower cost, and greater deployment range. On 16 June, drone 502 successfully completed a third launch from the M-21, as Kelly noted in his diary. ‘It flew about 1,600nm, making eight programmed turns, to stay within sight of the picket ship. It did everything but eject the package, due to some electronic failure.’

The fourth launch was to take place on 30 July 1966. Keith Beswick takes up the story.

> We briefed the previous day and reviewed details again the morning of the flights. Flight crew assignments were: Bill Park, pilot, and Ray Torrick, the launch control engineer, in Article 135 with drone number 504. Art Peterson would pilot for Article 134, and I’d be in the back seat as engineering observer. We then reviewed the aircraft maintenance status: fuel loads (this was the first time the D-21 would be launched with a full fuel load), tanker status and rendezvous plans, and our take-off plan – Article 134 and an F-101 chase would take off first and circle back to pick up 135 at the start of its take-off roll. The tanker refuelling order was 134 to hit the tankers first, so that 135 could begin its acceleration immediately afterwards. We then went through the aircraft’s instrumentation status for the test aircraft and telemetry ground stations, weather forecasts both en route and at the test site, and the en route communications.

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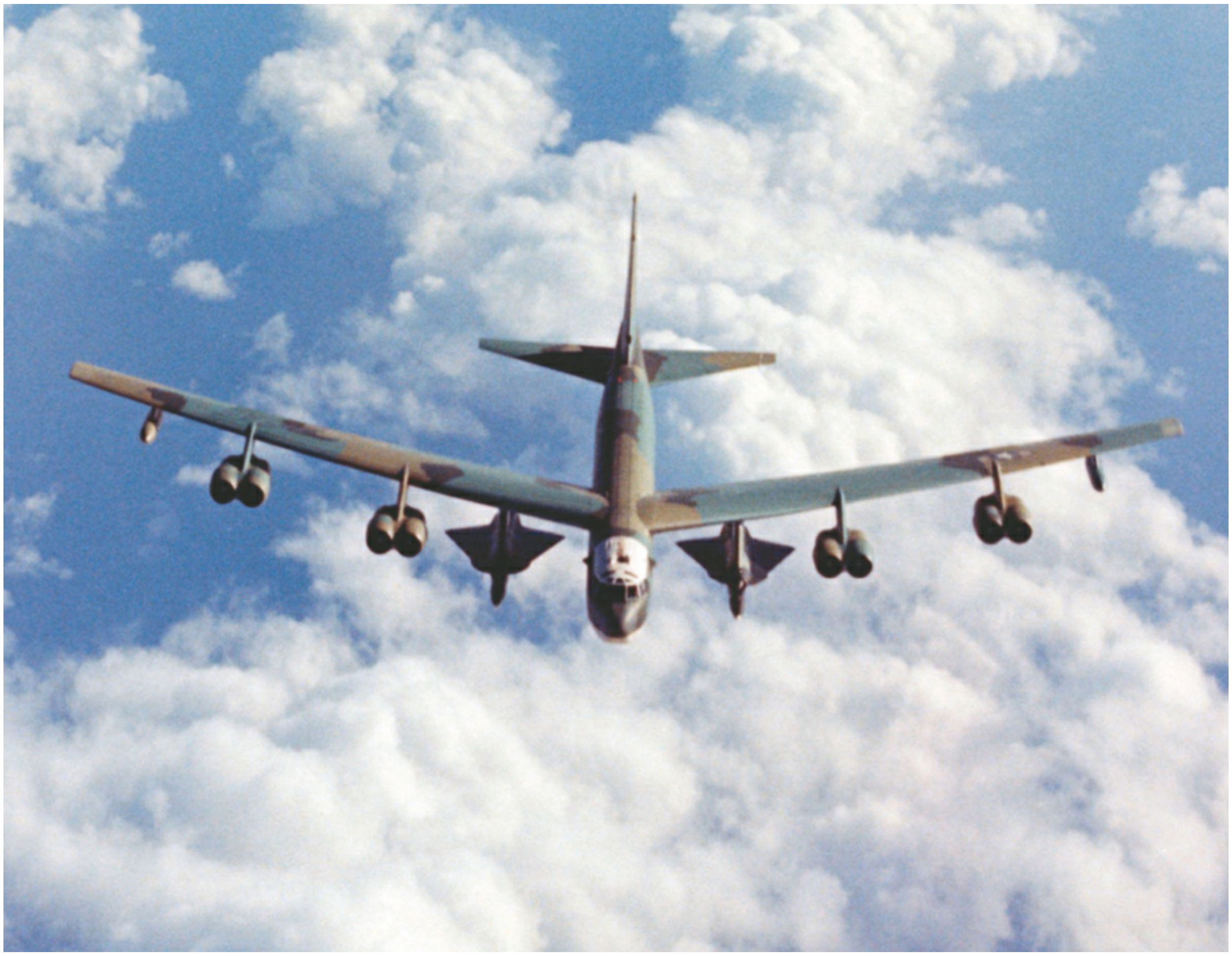
The second M-21, Article 135, was lost on 30 July 1966. (Lockheed Martin)

A frame grab from the high-speed camera carried by Keith Beswick in Article 134 captures the disintegration of Article 135 following its collision with drone 504. (CIA via Toni Hiley)



Project Senior Bowl used two B-52H Stratofortresses to launch D-21Bs equipped with a solid rocket booster, constructed by the Lockheed Propulsion Company in Redlands, to enable it to reach the required ramjet speed. (Lockheed Martin via Tony Landis)

We got suited up two hours prior to take-off and were airborne on schedule at 0700. The route was the same as on our practice launch flights. The flight from Dalhart was pretty routine, both aircraft reaching 3.2 Mach and 80,000ft about 200 miles east of Point Mugu. Article 134 was about 500ft off 135's right wing. I was operating a high-speed camera in the back seat of 134, watching the activity through the small viewfinder on the camera and trying to keep my helmet and the camera pointed in the same direction.

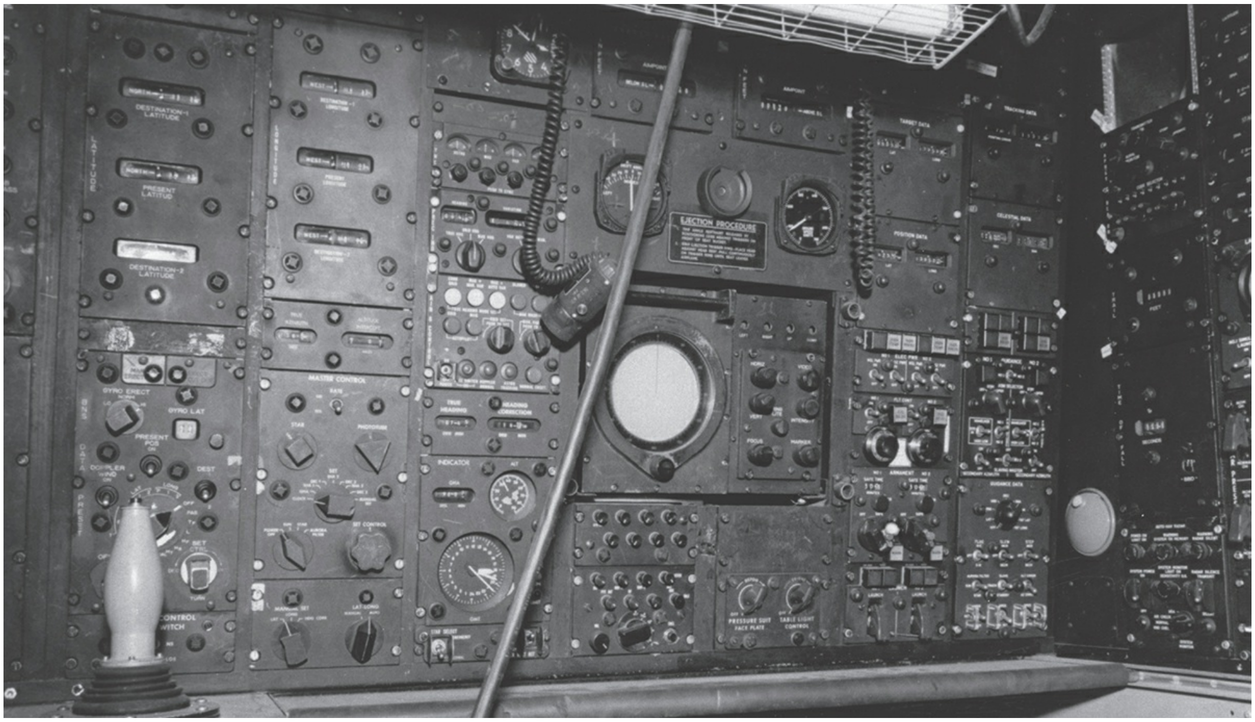
When launch occurred, the D-21 appeared to rise up then rolled to the right, crashing into the outboard trailing edge of 135's right wing. The airplane's nose pitched up to about 45° and then broke off and it was gone. Oddly enough, the aft fuselage seemed be flying along, trailing fuel, but quite stable. The instant we realized what was happening, Art Peterson yelled over the radio, 'Mark it, mark it, mark it,' so the Point Mugu radar operators would record the exact location to help subsequent search and rescue operations.

Inside the remains of the tumbling forward forebody, with their life-support pressure suits inflated, Park determined that despite their altitude and speed the chances of survival were better outside. Both he and Torick therefore ejected and made a 'feet-wet' landing in the ocean.

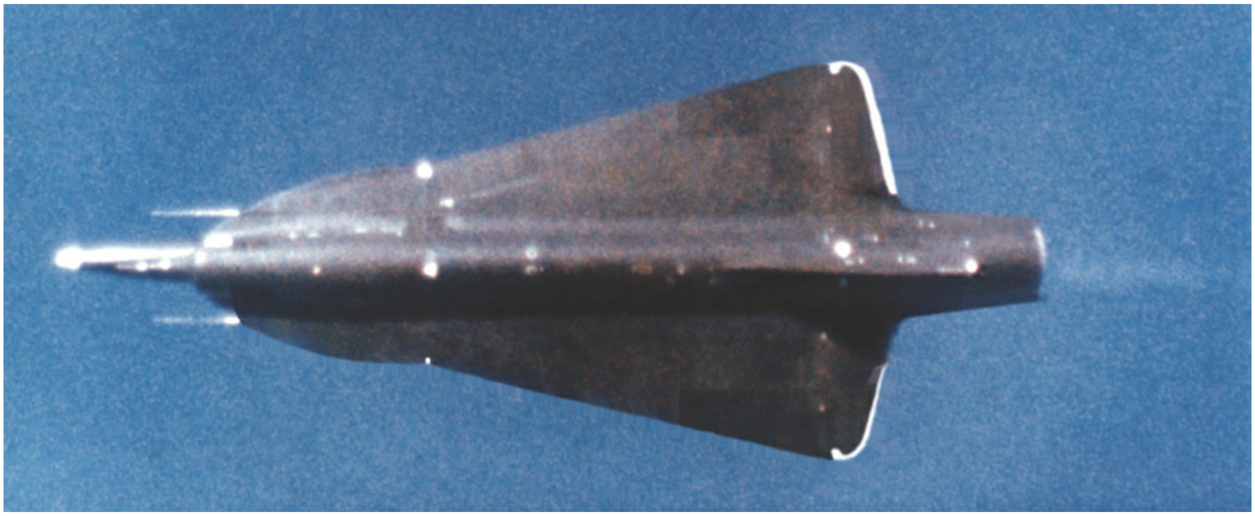
Keith Beswick continues: 'Our flight back to the test area went without incident, our mood sombre as we wondered about the fate of Bill and Ray and what had gone so badly wrong. An hour or so after we landed we were told that Bill and Ray were ok, but shortly afterwards we got further news that Ray had drowned.'

The facts as to what may have caused the collision remain largely conjecture, but the consensus is that the D-21 rose up slower through the M-21's shock waves (possibly because of its full fuel load) than on earlier test flights. This caused the D-21's inlet to unstart, which in turn would have disturbed the drone's hydraulic, electrical and flight control systems, which resulted in a loss of control at a critical stage of the launch process.

Following a review conducted by the NRO after the fatal Tagboard collision and completed in September, the Skunk Works was advised that it had been decided to reorientate the programme. The B-52 had already proved itself as an efficient, safe launch platform with NASA for dozens of different craft from lifting bodies to the X-15; therefore it had been decided that SAC would make available two B-52Hs from which to launch a redesigned variant of the D-21 (as Kelly had proposed back in May). Although this reorientated programme used exactly the same Marquardt XRJ-43-MA20S-4 ramjet, the D-21B's inlet was modified and fitted with a less sensitive pressure sensor. The major external change was the fitting of a large, jettisonable solid propellant rocket booster located under the drone's fuselage. When released from the B-52, the rocket accelerated the drone to a speed and altitude that enabled the ramjet to function. However, after the reorientation programme was under way, Kelly Johnson ascertained that the proposed solid rocket booster (SRB) required more thrust and therefore needed to be redesigned and increased in size, which inevitably led to delays.



The D-21B operator's console on the modified B-52H. (USAF via Tony Landis)



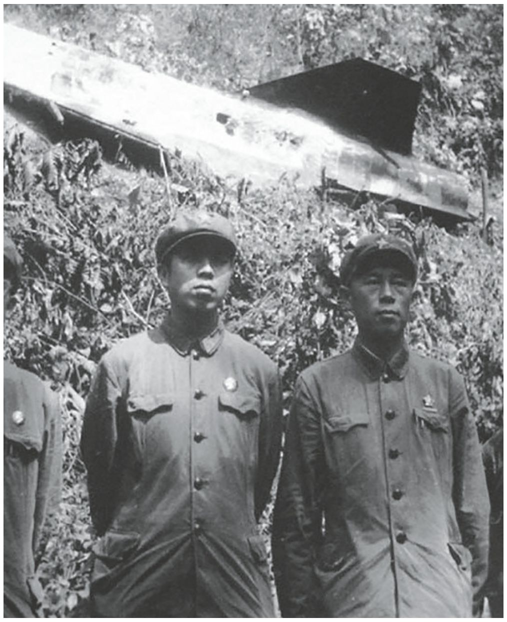
A D-21B in free fall from its B-52 launch pylon before the rocket booster is fired. (Lockheed Martin via Tony Landis)

The Avanti A-92 booster had a length of 44ft 3in., a case diameter of fractionally over 2ft 6in., a weight of 13,286lb, an average thrust of 27,300lb and a burn time of 87 seconds. Once the drone was released, at about 38,000ft, the booster was ignited, accelerating the drone out to Mach 3.2, at which point the functioning ramjet would take over and the exhausted rocket was jettisoned. Thermodynamic stresses on the drone during the launch sequence were severe, as the platform was blasted rapidly from an ambient temperature state of circa -60°C to cruise speed and airframe temperatures way above 220°C in under a minute and a half. To protect the drone from the rocket's hot exhaust gases, a flame shield-type nozzle was added to the rear of the rocket.

With its SRB ignited, the drone begins its rapid climb and acceleration away from the B-52 launch platform. (Lockheed Martin via Tony Landis)

The Avanti A-92 rocket booster had a burn time of 87 seconds and produced 27,300lb of thrust. (Lockheed Martin via Tony Landis)

The Air Force delivered the first B-52H (61-0021) for programme modification to the Lockheed Palmdale facility at Air Force Plant 42, Site 2, on 12 December 1966. A few months later it was joined by 60-0036. Designed to carry two D-21Bs on wing pylons located between the fuselage and the inboard engine pylons, the two B-52s had the ECM operator and tail gunner's panels situated in their upper-rear crew stations removed. In their place were installed identical launch panels for the D-21Bs on the right and left wing pylons.



Drone 527 was launched against the People's Republic of China on 20 March 1971. It was Senior Bowl's fourth and final operational mission. The drone was either shot down or crashed following a mechanical failure and is seen here after being found relatively intact. (Via Lin Xu)

Drone 527 being recovered through 'people power'. (Via Lin Xu)

The SAC unit tasked to operate the new programme, now codenamed Senior Bowl, was initially designated 'A' Flight, but later became the 4200th Support Squadron, based at Beale AFB.

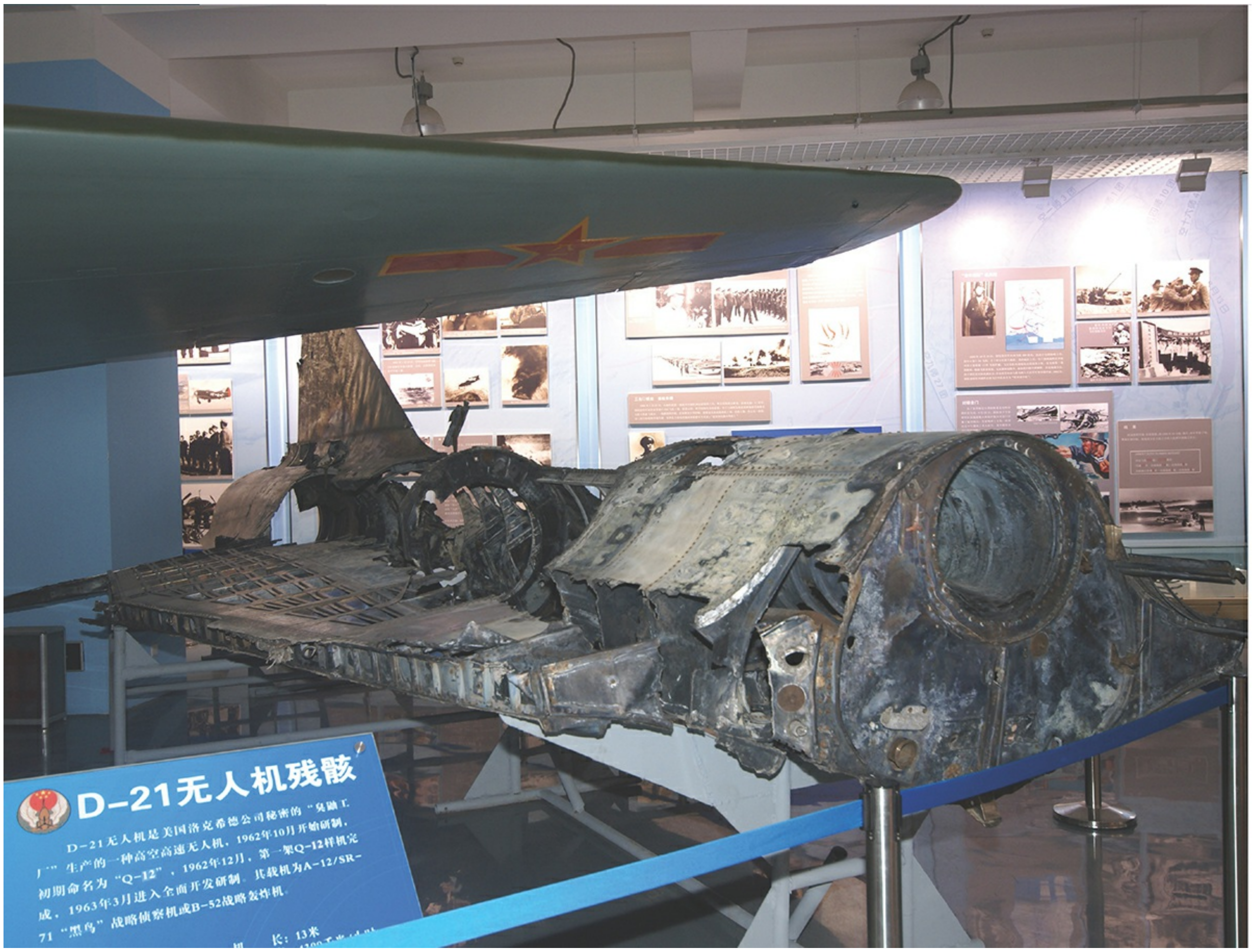
Between 6 November 1967 and 10 July 1970, 11 Senior Bowl flight test sorties were flown from Area 51, all using the Pacific Missile Range (PMR) located off the coast of California. Critical to the success of any operational mission would be the recovery of the drone's hatch that contained the INS, the Hycon HR-335 camera and its Kodak film. During five of the test sorties the hatch was successfully recovered on four occasions in mid-air by a JC-130, although on one sortie the services of the US Navy were called upon and the pallet was recovered from the ocean.

Once the system was declared ready for operations, the 4200th Support Squadron moved back to Beale AFB. On 9 November 1969 the first operational mission was attempted with D-21B number 517. The collection area was to be southern China. To maintain tight security, the B-52, hauling its unique payload, departed Beale at night and lumbered westwards to Andersen AFB on the Pacific island of Guam. Just before dawn the next day the flight resumed, the 'bomber' departing Guam and heading for the launch point. Upon vehicle separation, the B-52 made its way back to Guam while the drone climbed and accelerated on course to China, ready to begin a daytime reconnaissance run.

During the sortie, both the launch and boost phase were successful and the drone attained its programmed altitude of 84,000ft and a cruise speed of Mach 3.27. The NSA reported that with the drone's telemetry turned off 50 miles off the island of Hainan and 80 miles from the Chinese mainland, well within the range of coastal air defence radars, no SIGINT activity could be correlated with the mission.

However, a phenomenon known as integration error in the drone's INS prevented it from flying the pre-programmed route. It is believed that 517 continued on its initial track, which carried it far into the wilderness of the former Soviet Union before its self-destruct charge was triggered automatically upon descent after the craft's fuel supply had been exhausted.

On 20 February 1970, drone 521 completed a flight test sortie into the PMR. Fail-safe modifications to the INS software were validated, the hatch was air-recovered by a JC-130 and once again it was time to attempt another operational mission.



Having undergone a thorough evaluation by officials and engineers, 527 spent many years languishing in a museum junk yard before being rediscovered and put on permanent display. (Via Lin Xu)

The second operational mission was undertaken by D-21B airframe number 523 on 16 December 1970. This drone completed its 2,648nm sortie only to lose its payload at sea following a partial parachute failure.

During operational mission number three, flown by drone 526 on 4 March 1971, the 2,935nm flight was completed flawlessly. The recce pallet was ejected and its 'chute fully deployed, but unfortunately the JC-130B missed the aerial recovery and the valuable payload splashed into the Pacific. Procedures for such an eventuality had been prebriefed, however, and with a US Navy recovery ship on station all was apparently not lost.

The vessel failed to recover the pallet on its first pass, so a Navy SEAL team went over the side to render assistance. But the pallet was still attached to the parachute cables and these were reinforced with stainless steel wire. The SEALs couldn't cut through them; even worse, the drone's parachute now acted as a sea anchor, so that when the vessel made a second attempt at recovery by positioning upwind and drifting towards the floating pallet, it drifted over the top, keel-hauling it and consigning it forever to Davy Jones's Locker.

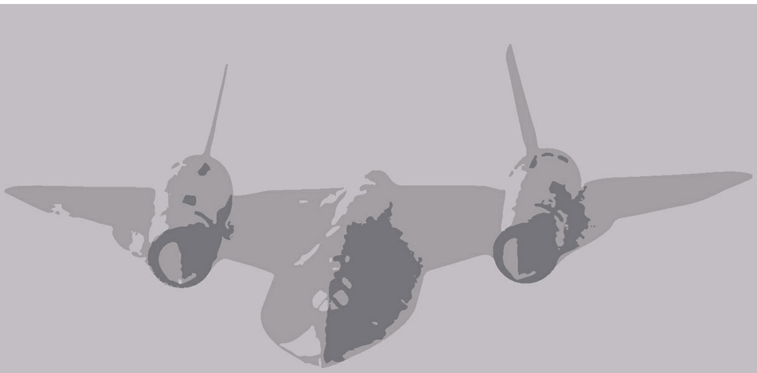
The fourth and final mission was flown just 16 days later by number 527 on 20 March 1971. It was lost on the last leg of the route over the People's Republic of China in Yunnan province, and the wreckage was recovered by local authorities. In 2010, it was moved from China Aviation Museum's junkyard and put on display.

Intelligence sources have stated that Chinese radar controllers managed to track the D-21 over their territory at least once, incorrectly identifying it as 'The Big One', their adopted term for the SR-71. The incident resulted in Peking protesting to Washington that SR-71s were violating its sovereign airspace and this, and similar incidents formed the basis of rumours that have persisted ever since. Indeed, President Richard Nixon perpetuated such rumours when, during the course of his state visit to China in February 1972, he promised that 'all SR-71' overflights of China would be halted.

On 23 July 1971, the Senior Bowl programme was cancelled, due to its poor success record. At a cost of $5.5 million (1970 dollars) per mission, it had failed to produce a single image of denied territory, despite the best efforts of an outstanding team. In addition, a new generation of photo-reconnaissance satellites had been developed, the use of which was more politically acceptable over sovereign nations than manned aircraft or drones.

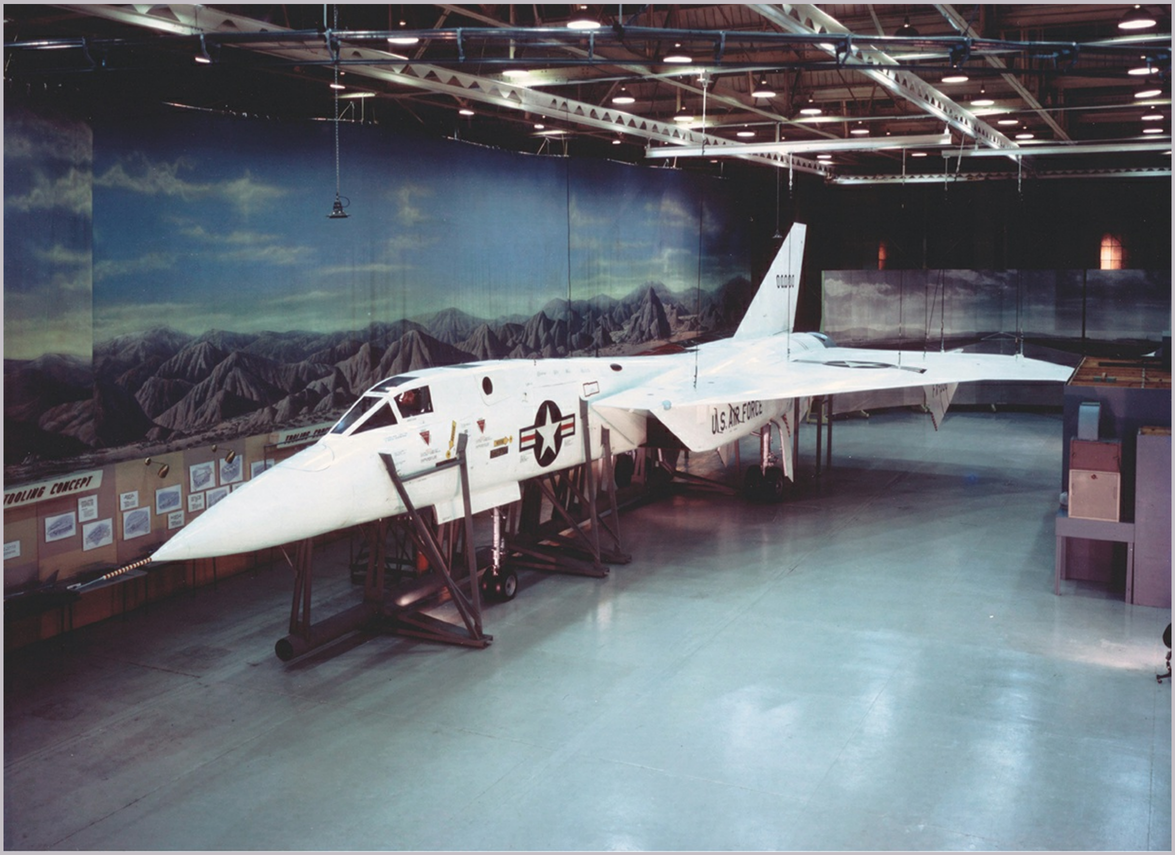
In total, four D-21s were launched during Tagboard and 16 D-21Bs during Senior Bowl. Thirty-eight were built and those that remained were initially stored at Norton AFB, before being moved to the 309th Aerospace Maintenance and Regeneration Group (AMARG) at Davis-Monthan AFB, Arizona, which is where they were first spotted by 'outsiders' in 1976. Since programme declassification, many have been placed on loan as museum exhibits.

In a final interesting twist, many years after the cancellation of Senior Bowl and after Ben Rich had retired as president of Lockheed's Skunk Works, he recalled how during a visit to Moscow he was presented by the KGB with what they believed were the remains of a 'stealth fighter' that had crashed in their territory. Checks on arrival back home indicated that in fact the 'trophy' had come from D-21B 517.



CHAPTER 8:

KEDLOCK


U.S. AIR FORCE
TOOLING CONCEPT

The North American F-108 Rapier was to be equipped with the Hughes AN/ASG-18 fire-control system, but it never progressed beyond the full-scale mock-up stage. (USAF via Tony Landis)

During the late 1950s a specification was drawn up to provide a fire control and missile system for the North American F-108 Rapier interceptor. Improved Manned Interceptor (IMI), the F-108 was to be Mach 3.0 capable and its AN/SG-18 pulse-Doppler radar system, developed in parallel with the GAR-9 Falcon missile by Hughes, would have a look-down/shootdown capability for head-on attacks. Furthermore, the system considerably advanced the maximum range of contemporary airborne intercept monopulse systems then in use, from 40 miles to 120 miles.

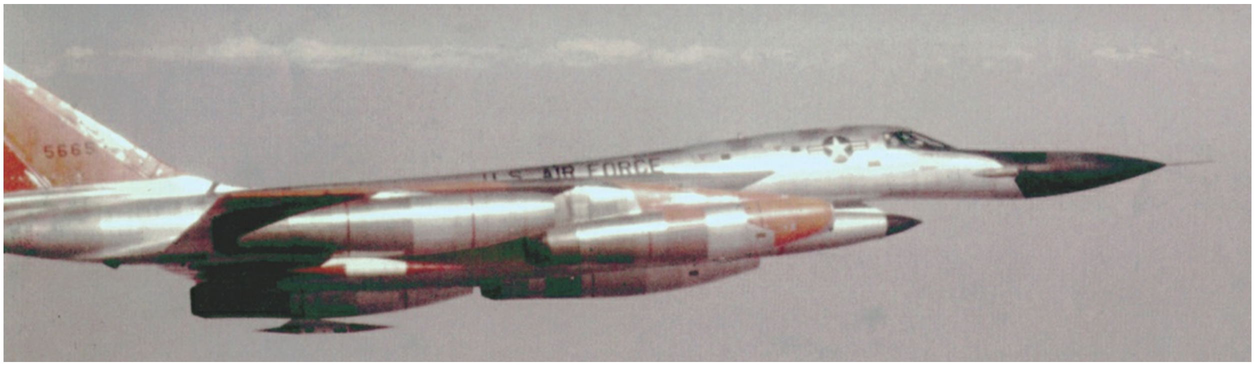
As development of aircraft and avionics progressed, a Convair B-58 (55-665) was bailed to Hughes to act as a systems testbed. Delivered to the Hughes main plant at Culver City, California, it was on the ground in excess of a year while re-configuring work prepared it for the missile and ASG-18 fire control system (FCS) flight test programme. While this was being undertaken, Hughes engineers were using high-speed techniques and a 9ft-deep pit filled with foam to analyse separation and pitch characteristics of the 818lb missile. In the air missile/vehicle separation was provided by two 'thrusters', one located at each end of the missile. On firing, these charges unlocked the missile from its rail and then forced the missile down, clear of the aircraft. At a finite time, its rocket motor ignited and the GAR-9 sped away.

MR MISSILE

Jim Eastham, a native of El Dorado, Kansas, began his aviation career in 1942. Having graduated as a primary flight instructor, he was called to active duty two years later. Completing his US Army Air Force pilot training in class 45-1, he graduated and received his commission at Luke Field, Arizona. One of the original Berlin airlift pilots, Jim flew a number of aircraft types, including F-84s, with the 31st Strategic Fighter Wing.

Released from active duty, he gained a mechanical engineering degree from Georgia Tech in 1955 and became a production test pilot with the McDonnell Aircraft Corporation on the F2H Banshee and F3H Demon. Jim's next move ultimately earned him the nickname 'Mr Missile' when, in October 1956, he joined the experimental flight test department of the Hughes Aircraft Company and was assigned as project pilot on the Falcon missile programme at White

Sands Missile Test Range, New Mexico. Over the next four years, Jim flew almost 800 test missions in the F-102 and F-106, firing in excess of 350 missiles – a record for one pilot.



YB-58 55-665 nicknamed 'Snoopy 1' was used to flight-test the AN/ASG-18 FCS and GAR-9 (later AIM-47) missile. The aircraft's nose section was extended by almost 7ft to accommodate the new attack radar system. (Jim Eastham)

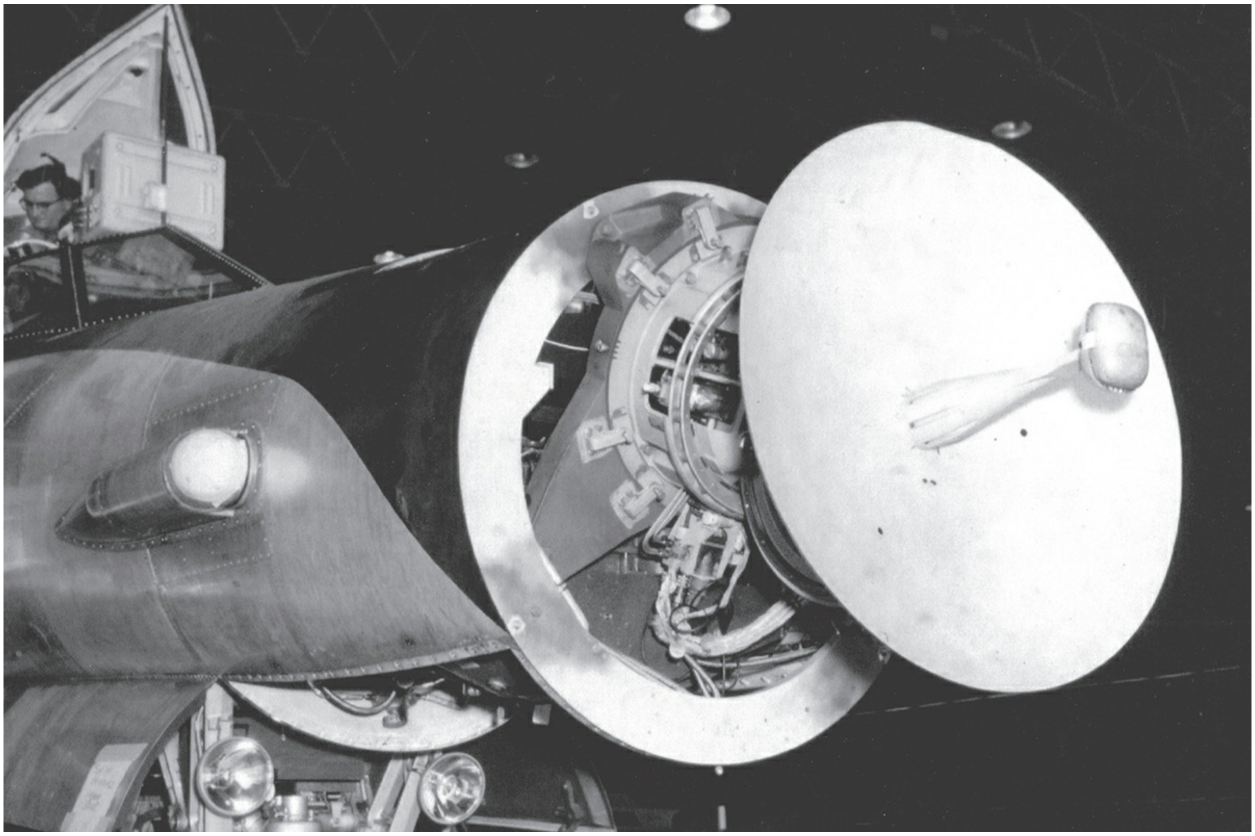
In 1961 and with work progressing well at Culver City, Jim attended the B-58 combat crew training school at Carswell AFB, Texas, where he graduated first in his class, thereafter becoming the Hughes project test pilot on the YB-58 ASG-18/GAR-9 programme. Hughes also provided fire control officers (FCOs), two of who would occupy the tandem positions behind Jim. Their task was to monitor the entire system and fire the GAR-9. During the course of this programme, Tony Byline, Lyn Gear, John Moore, Jess Le Van, John Archer and later George Parsons and Ray Scalise all became intimately familiar with these duties.

ASG-18 AND GAR-9

The AN/ASG-18 employed a high average-power, liquid-cooled, travelling wave tube transmitter chain that consisted of two travelling wave tube amplifiers set in tandem to provide the desired gain, plus analogue circuitry for generating and processing a coherent high pulse repetition frequency waveform. The entire package included a solid-state digital computer for navigation, attack and BIT; integrated controls and displays; missile auxiliaries; an analogue attack steering computer; and an infrared (IR) search and track set capable of cooperative use with the radar.

The effective range of the IR system depended upon the point where either it traversed over the horizon or something appeared between the target and the system. All early IR systems used an uncooled lead sulphide sensor-cell and operated in the short wavelength of 2–2.5 microns. This generated countless discrimination problems, so Hughes continued development work in this field, utilizing the F-102 that Jim Eastham flew out of Holloman AFB, and eventually produced a long wavelength sensor cell using an indium antimonide cell cooled by liquid argon. This worked in the 3–5 micron range and had an outstanding discrimination capability. The IR system installed in the YB-58 and AF-12 was yet another development and it used a lead selenide cell cooled by liquid nitrogen. However, extensive testing of this system would never be carried out.

On completion of modifications to the YB-58, the programme was moved to the Hughes facility on 'Contractors' Row' at Edwards. Despite the cancellation of the F-108 programme on 23 September 1959, DoD officials decided that the outstanding FCS and missile development programme should continue on a 'stand alone' basis.



The AN/ASG-18 could use infrared target tracking. A blister to either side of the YB-58's forward fuselage housed the IR tracking sensors. (Jim Eastman)

With the modified YB-58's first FCF successfully completed, the next order of business was to undertake a BIT check flight of the ASG-18 in the aircraft. During the following missions, the team was tasked to monitor the tracking capabilities of the FCS against Titan and Atlas ballistic missiles launched from Vandenburg AFB. Jim recalls: 'The mission against the Titan was only partially successful because a problem developed in the velocity gate of the ASG-18. But during the next sortie, against the Atlas D, we acquired the missile and tracked it with the ASG-18 until the antenna hit the bumper-ring. The IR tracker was slaved to the radar and it too acquired the target and tracked it until its antenna hit the IR bumper-ring.'

But progress was slow during this first year, with B-58 accidents throughout the SAC fleet causing numerous groundings of '665. During this off-and-on testing time, a question arose concerning the effectiveness of the ASG-18's ability to detect an extremely low-altitude target. It was soon answered, however, when the system actually locked onto and tracked a B-57 at long range as the target completed a 'touch-and-go' landing at Edwards.

KEDLOCK

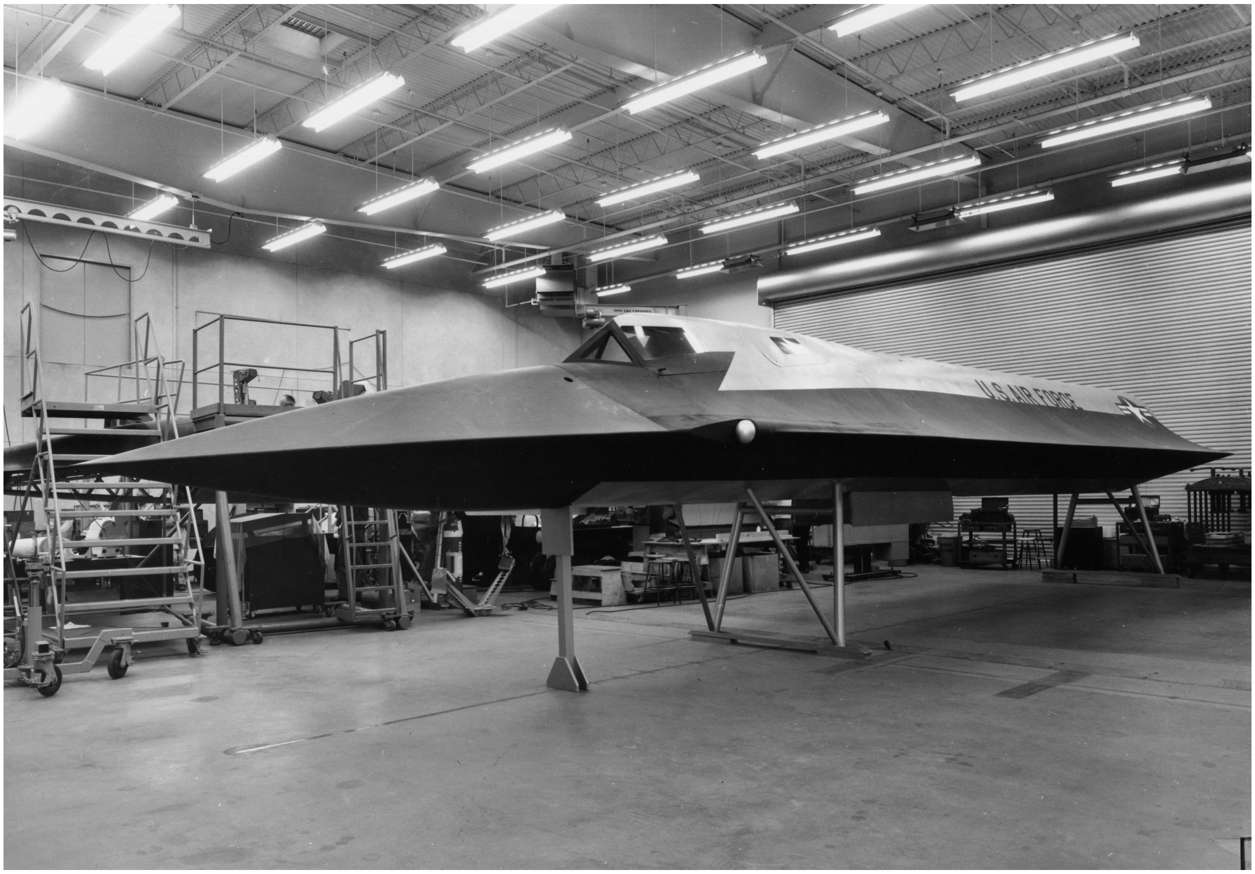
Undoubtedly spurred on by the earlier success of his A-12 design with the CIA, Kelly Johnson discussed the possibility of building an interceptor version of the A-12 for the Air Force over 16/17 March 1960, with Gen Hal Estes of Air Force Systems Command and Dr Courtland Perkins, the Air Force Secretary for Research and Development.

Referred to by Kelly as the AF-12, his ideas were keenly received and subsequently forwarded to Gen Martin Demler at Wright Patterson for further discussion and analysis. During late October 1960, Lockheed received a letter of intent for $1 million and was directed to 'go forward with Plan 3A' and produce an interceptor version of the A-12. Equipped with the Hughes ASG-18 FCS and the GAR-9 missile system, the programme was accorded the classified code name Kedlock.

Kelly appointed Rus Daniell to become the project engineer and the seventh

A-12 was nominated to become the AF-12 prototype. In December 1960, a Kedlock project group was organized at the Skunk Works; in order to maintain security, it worked independently of the Oxcart team.

This frame grab shot from a chase aircraft shows the debris field resulting from a GAR-9 missile strike. The target was a QF-80 remotely piloted drone carrying an augmentation pod, the YB-58 having fired the weapon from 23nm. (Jim Eastman)



The YF-12A forward fuselage mock-up. (Lockheed Martin via Tony Landis)

A considerable amount of work was necessary to convert the reconnaissance platform into an interceptor, although it's fair to say that most of this was focused around the forebody of the aircraft. Initially these external changes were typified by the creation of a second cockpit in the A-12's Q-bay. The fuselage 'chines' were cut back to incorporate a radome that housed a 40in. radar scanning dish, and four weapons bays were added, cut into the underside of the 'chines'. These would house the FCS (in the right forward bay) and three GAR-9 missiles (two in the left bays and the third in the right rear bay).

On 23 and 24 January 1961, the first meetings with the Air Force's Weapon System Project Team took place at Burbank, where they were briefed on the Skunk Works design and development philosophy. On 31 May, some 15 Air Force officers returned to the plant and completed a review of an AF-12 mock-up; all seemed to be progressing extremely well.

However, by June, wind tunnel tests had revealed serious directional stability problems resulting from the reconfigured nose section and the slightly raised second cockpit. To alleviate the problem, further external modifications were necessary, this time to the rear of the aircraft, where a fixed ventral fin was installed on the underside of each engine nacelle. In addition, a large folding fin was mounted at the rear on the aircraft's centreline. Folding and extension of the folding ventral fin worked out of phase with the cycling of the landing gear, so that when the gear was retracted, the fin extended and vice versa.

Generally, the fin-fold system worked well, but on one occasion Lockheed test pilot Bill Weaver found himself flying a YF-12 with a ventral fin that stubbornly refused to fold. Nonetheless, he successfully landed the aircraft and the fin's profile was considerably modified by the incident.

One evening early in 1962, Jim Eastham was at his home in Lancaster, Nevada, when his doorbell rang. He answered to find Lou Schalk – a long-standing friend – at the door. Jim recalls:

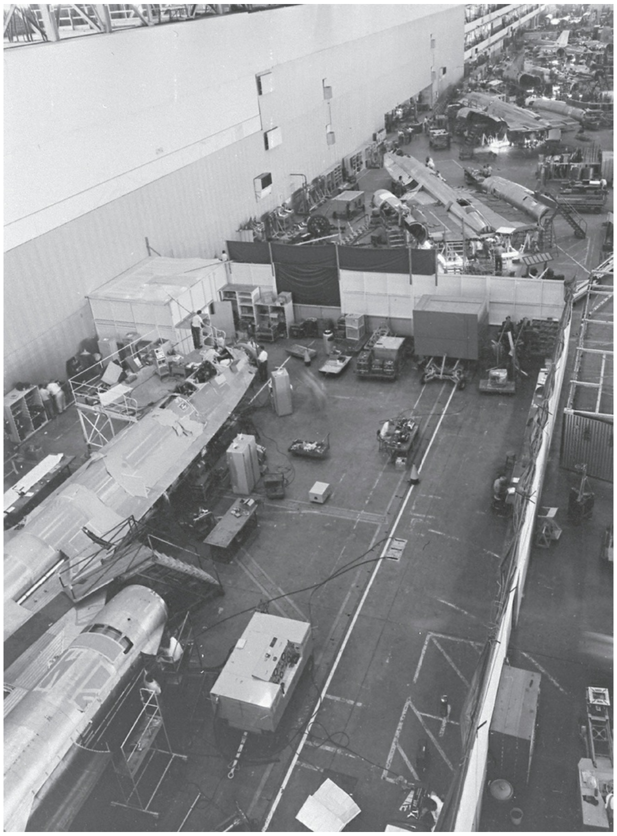
> At first I thought that Lou had swung by on his way to visit family who lived in Lancaster; but he said no, he'd come to visit me! I invited him in, poured a couple of 'cold ones' and asked what was on his mind. He said he wanted me to go and work for him. But when I asked him what I'd be doing, he said he couldn't tell me.
>
> I responded by saying, 'Lou, I'm flying the B-58, it doesn't get any better than that!' And Lou said, 'This is a hell of a lot better than that!' So I replied that I was definitely interested! I suspected that Lockheed were developing a new interceptor and that it would be using our weapon system and missile. He arranged for me to have a meeting with Kelly Johnson and I drove down to Burbank.
>
> When I got there, Johnson put his fat finger in my face and said, 'You'll continue to do what you're doing and we'll find something for you to do around here.' And that is the origin as to how I ended up working simultaneously for two companies! I would hasten to add, I didn't receive two base salaries – for the next two years, my primary pay continued to come from the Hughes Aircraft Company.

Once an extensive security check had been completed, Jim began spending time with Skunk Works engineers at Burbank, familiarizing himself with the location of switches and other specialist equipment in the AF-12 mock-up.

His second year of flight testing with the YB-58 involved integrating the missile into the aircraft and tailoring it to work with the radar system. This extremely complex task was carried out under the direction of Clare Clausen, the programme manager, and involved some of the finest electrical engineers in the Western world.

First of all, captive flights were performed, which involved making runs against manned aircraft and checking out the radar and missile system to the point of launch. Subsequent analysis of the recorded data would isolate problems that were apparent to the flight crew during the sortie. Then, after missile separation tests, which included some unguided firings, about six live guided firings were made by Jim and his team in the YB-58 over the White Sands missile range.

By 2 August 1962, Air Force funding had been increased to allow for the modification of three A-12s on the production line, and the major elements of the prototype, assigned Article number 1001, were in the jig at the Skunk Works. As the manufacturing effort continued from December 1962 through to the spring, reservations were muted in some quarters about the security of the Oxcart programme and that of its fighter stablemate, particularly in relation to the latter's fast approaching flight test programme. Edwards certainly appeared to offer the best option for flying, but in the event, 1001 was crated up and trucked to Area 51.



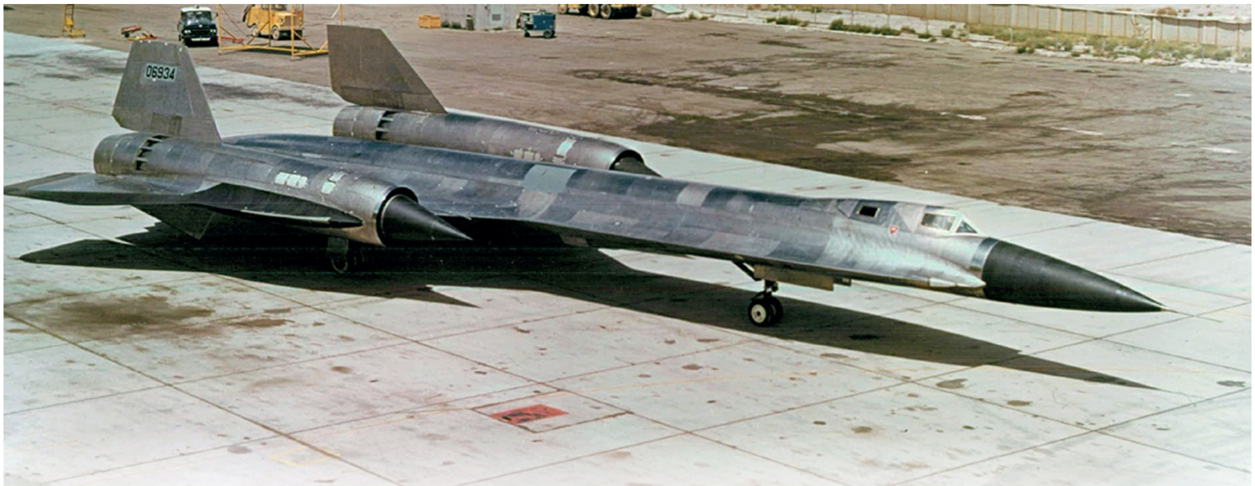
Workers involved in the Kedlock programme were not cleared for access to Oxcart, so the three YF-12s were built within an area partitioned off from the rest of the Skunk Works. (Lockheed Martin via Tony Landis)

With Jim now spending an increasing amount of time at Area 51, Lou Schalk and Kelly agreed that he should be the first pilot to fly the AF-12, which by now the Air Force had designated YF-12A. Consequently in March 1963, Jim began writing the *Flight Manual*, or ‘Dash 1’. This rather complicated volume consisted of 12 sections that covered every aspect of normal and emergency operation and required Jim to move in with the engineering section concerned with each particular subsystem. He also spent a good deal of time with the aerodynamicists; having already flown the A-12, this outstanding engineering test pilot was anxious to learn the differences between the two Skunk Works birds.

OUTLINE DESCRIPTION

The YF-12A was 101ft 8in. long, stood 18ft 4½in. high, had a wingspan of 55ft 7½in. and a wing area of 1,605sqft. The wing featured a leading edge sweepback of 61.25°, it had no dihedral, and its angle of incidence was 1° 2’.

The empty gross weight of Article 1001 was 60,730lb, the specification being 59,422lb, and maximum take-off weight was 127,000lb, with the specification being 124,491lb.



YF-12A Article 1001 (60-6934) at Area 51 as it appeared on its maiden flight, prior to black paint being applied to the fuselage chines. (CIA via Tony Landis)

On the ground the aircraft was supported by a tricycle undercarriage with a main wheel track of 37ft 9½in. The aircraft’s centre of gravity (CG) limits were between 16 and 29 per cent of the mean aerodynamic chord (MAC) and its G limits were -1 to +3.6.

Interestingly, the aircraft's maximum allowable airspeed and its design speed were equal, 450kt equivalent airspeed (KEAS). KEAS was used throughout the A-12/YF-12 and SR-71 programmes when speed criteria needed to be followed because aircraft are designed structurally using KEAS and it also enabled one airspeed limit to be specified for all altitudes.

Prohibited manoeuvres were spins and roll rates in excess of 120° per second, and take-off rotation had to be limited to less than 14° or the engine nacelle ventral fins would contact the runway.

FUEL SYSTEM

The YF-12 used a fuel referred to in the Flight Manual as PWA 523B, more commonly known initially as PF-1, before JP-7 became available. Possessing a high flashpoint, it also contained a liquid Teflon additive to lubricate the engine hydraulic pumps and various engine accessories. The fuel density averaged 6.4lb per US gal. Fuel tank capacities were:

Tank 1	936 gallons	5,990lb
Tank 2	1,230 gallons	7,872lb
Tank 3	1,485 gallons	9,504lb
Tank 4	2,132 gallons	13,645lb
Tank 5	2,141gallons	13,702lb
Tank 6	1,950 gallons	12,480lb
Total	9,874 gallons	63,193lb

Fuel was moved from one tank to another using 16,200V, 400-cycle booster pumps; tanks one and six each had four pumps, while the remaining tanks each had two. Tanks one, three, four and six fed the left engine; tanks one, two, five and six the right. Fuel could be used in either engine using the cross feed control. A jet pump system removed any residual fuel from a tank that had stopped pumping into the feeding tank. For example, when tank one stopped pumping, a jet pump in tank two pumped residual fuel in tank one into tank two.

Jim Eastham was Lockheed's chief test pilot on the YF-12A: he's pictured here wearing a David Clark S-901 pressure suit. The 'yellow box' to his left is a portable oxygen and environmental control unit. Eastham's personal call sign was Dutch 52. (Lockheed Martin)

ELECTRICAL SYSTEM

The YF-12 had an awesome electrical system – it had to, as the ASG-18 alone required 40KVA to operate! To satisfy this veracious appetite, the aircraft was equipped with two 60KVA, three-phase, 400-cycle, 200v, three-phase, 115v single-phase 175A alternators. They were driven by a Sundstrand constant-speed drive turning at 8,000rpm.

Two transformer rectifiers supplied DC power to the aircraft, while a small silver-zinc battery, located in the nose wheel well, provided 15 minutes of emergency DC electrical power. An inverter supplied emergency instrumentation power and lights for about 15 minutes. During normal operation, the inverter furnished power to the stable platform; during emergency operation, this dropped off.

A 40hp compressor ran the ASG-18's cooling package. It had an inrush current that ranged from 500 to 600A and a running current of 100A.

COMMS EQUIPMENT

For communication purposes, the YF-12 was equipped with two Collins

ARC-51 UHF radios that provided 1,750 channels, two Collins 618-7 HF single side band radios and an AIC-18 intercom. An ITT ARN-52 with 128 channels provided TACAN capability; an ARN-58 built by GFE equipped the YF-12 with the air component of an ILS; and in the rear cockpit was the APX-46 IFF display.

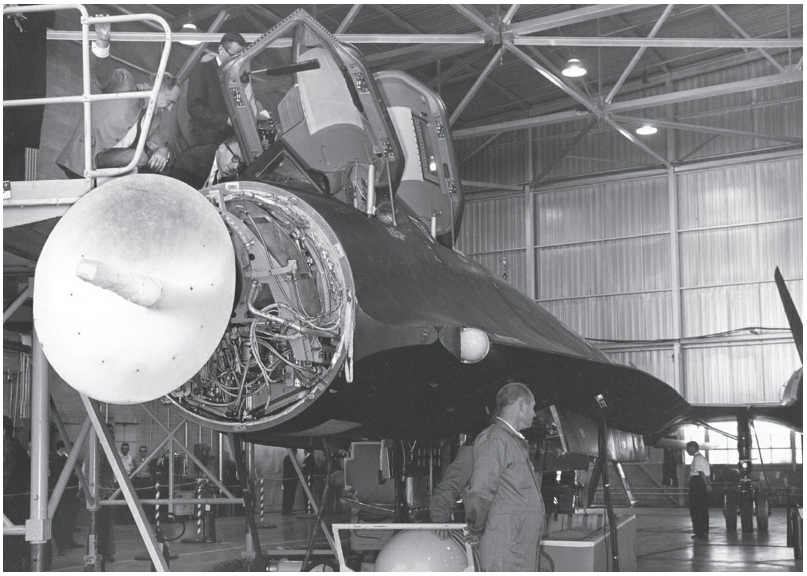
HYDRAULIC SYSTEMS

There were four hydraulic systems designated Left, A, Right and B. They used a hydraulic fluid known as SP-302, which was a highly de-waxed mineral oil. Nine Vickers pumps were used across the four systems and they each produced a pressure output of 3,350psi. There was one reservoir for each system, located in the main wheel well; in addition, a reserve hydraulic reservoir with a capacity of 10US gals at 500°F provided a standby for the A and B system reservoirs when either dropped down to the 1US gal level.

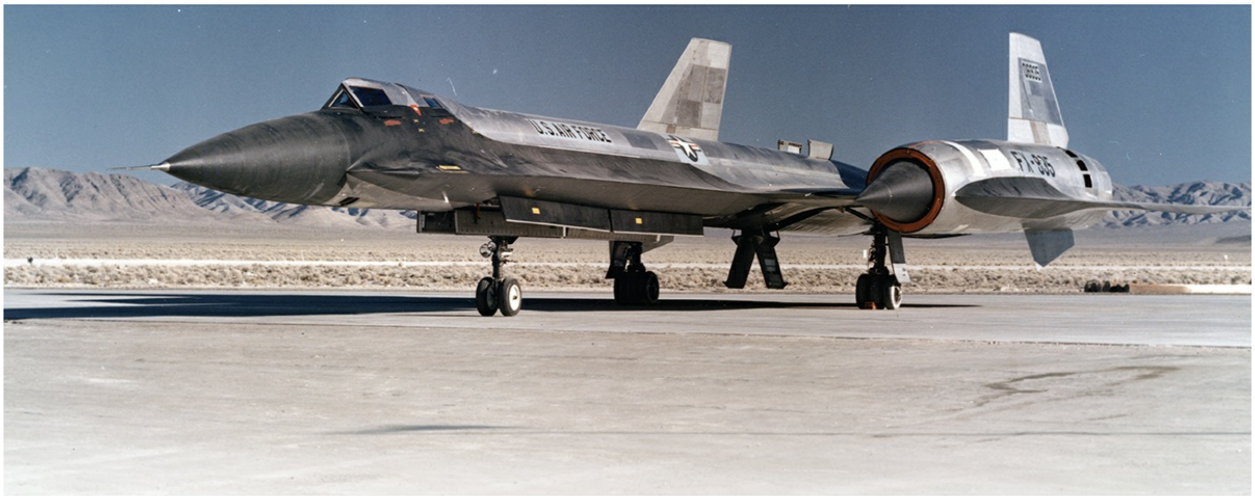
PREPARATIONS FOR FLIGHT

Once Article 1001 had arrived at Groom Lake, several weeks were spent assembling the aircraft and equipping it with new J58 engines. Little in the way of an FCS was installed at this stage. After a few wrinkles in the electrical system were ironed out, engine runs were made. The hydraulics were checked to ensure they functioned correctly and were leak-free. The SAS was brought on line and checked to ensure it would engage and function properly. Further ground tests on the J58s involved operating at full power to ensure that their output agreed with Pratt & Whitney's performance data schedule.

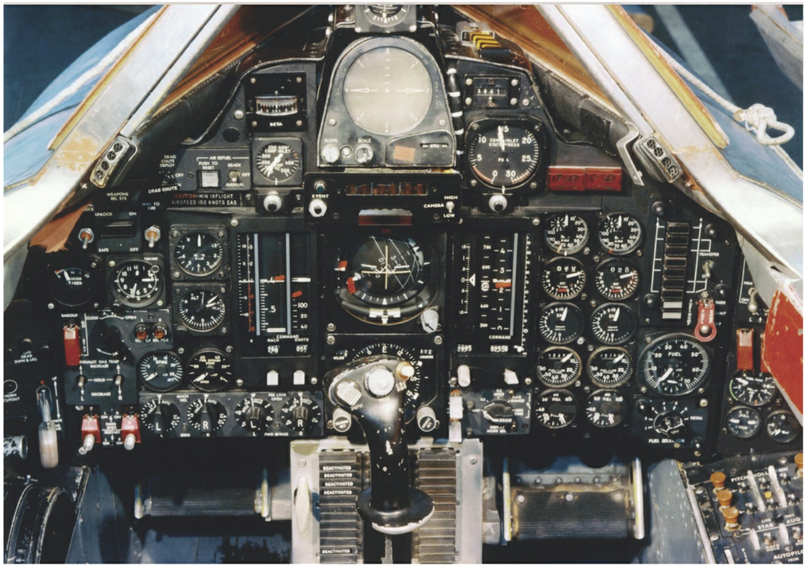
Early taxi tests uncovered a slight problem in the brake and damper system. Once this was resolved a high-speed taxi test was undertaken to near take-off speed; when this was reached, the power was chopped and the brake chute was deployed. Having satisfied all the ground requirements and determined that all instrumentation and communication equipment functioned properly, the YF-12 was deemed to be ready for its maiden flight.



The Hughes AN/ASG-18 FCS used a massive 40in. array. Note the IR sensor mounted in the shoulder of the cut back chine and the camera located on the right of the raised forward canopy. This photographed cockpit instrumentation for later analysis. (Lockheed Martin)



The second YF-12A, Article 1002 (60-6935), parked on the ramp at Area 51 with all four weapons bays and the brake chute doors open – note black paint applied to chines and wing leading edges. (Lockheed Martin via Tony Landis)

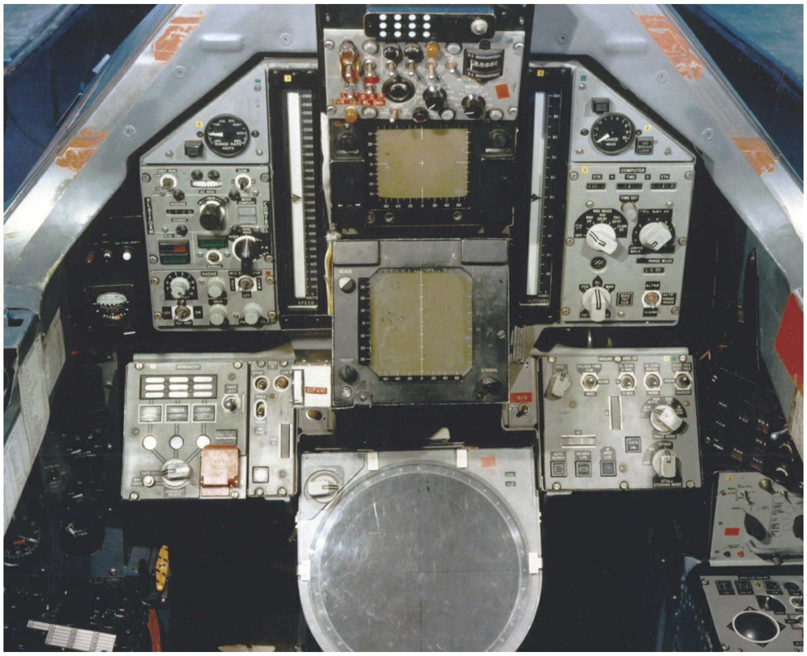


The front cockpit of the YF-12A shows its strip-type instrumentation for airspeed and altitude. (Lockheed Martin)

On 7 August 1963, Jim Eastham climbed aboard 60-6934 for a first flight that he later modestly characterized as a typical production test flight, chased by Lou Schalk flying an F-104. On that smooth flight, the YF-12's powerplant, control system and SAS were checked for proper operation and the electrical, hydraulic, environmental and pressurization systems were checked as satisfactory; the vertical instrument indicating Mach number and KEAS also functioned well. (SAC generals vetoed this type of instrumentation for the SR-71, in preference for 'old standard' round dials.)

Some minor handling quality checks were conducted, followed by an appraisal of the aircraft's static stability. Checked in all three flight axes, the YF-12 appeared, at least subsonically, to be 'much the same as its Black World stablemates'. Because of its stability, Jim was of the opinion that the aircraft 'carried enough tail'. With all systems functioning well, the power levers were advanced into full military power and the aircraft went supersonic. This presented no problems in either the transonic or low supersonic regions, where handling characteristics were once again assessed as identical to those of the A-12.

After deceleration to subsonic speed, the aircraft was prepared for landing back at Area 51. When the gear was lowered a cockpit light indicated that the ventral fin had retracted – this was visually confirmed by Lou Schalk. The approach phase was characterized as identical to that of the A-12. Concern over available ground clearance for the ventral fins during flare prior to touchdown proved unfounded and the near perfect 'squawk free' test flight ended with the successful deployment of the drag 'chute.



The FCO's cockpit instrumentation was dedicated to control of the YF-12's formidable weapons system. Three displays provided target, ranging and position data, with radar control panels to the left of the square displays, armament controls below these, radar and IR controls opposite to their right, and computer controls above these. The FCO was also provided with airspeed (on the left) and altitude information (on the right) via vertical tapes. (Lockheed Martin)

Kelly would later note in his AF-12 log, 'It is the first airplane I've ever worked on where the fire control system was checked out prior to the first flight.' With the first flight completed with flying colours, there was little urgency in getting the YF-12 out to design speed since Lockheed had already achieved the full speed envelope with Oxcart. Instead, time was spent installing the FCS, ensuring that it integrated into the YF-12, and testing the INS.

GOING PUBLIC

With the Oxcart flight test programme now in full swing, and a notable increase in Cygnus test and training sorties, questions were being raised as to how much longer the project could remain hidden. In a secret memo dated 11 January 1963, from the Chief of Security Branch, OSA, addressed among others to the OSA's Assistant Director, Jack Ledford, a course of action was outlined to protect Project Oxcart during 'surfacing of the USAF X-21/R-X Program'. Point 2 of the memo recommended 'a coordinated, timely and thorough briefing of key governmental and industrial officials who may be called upon to respond or react to the initial release of the X-21/R-X Program'. Point 3 of the memo proposed that 'items enumerated in referenced memorandum be immediately coordinated with Headquarters USAF, and promulgated to AFCIG-5 and the Kedlock Project Office at Wright Patterson AFB,' and that these two offices should be the 'focal points within USAF for all Oxcart/Kedlock security procedures.'

It then went on to advocate that once those with a 'need-to-know' had been briefed by CIA security agents, a briefing should be prepared that would admit the existence of a programme, but which 'intends to publicize a minimum of detail'. For those connected with the programmes, 'Security Rules remain the same, without relaxation concerning the capabilities of our hardware, delivery schedules, names of other contractors, production numbers and state of flight tests. This is the rule, regardless of what you may see or hear through public news media.'

In sub-paragraph 'e' of the memo, its originator recommended, '(probably subsequent to the release) change the names Oxcart and Kedlock. The new Oxcart designation will in future refer only to individuals witting of the CIA, A-12, sponsorship and operation. The new Kedlock designation will be used for all individuals whose need-to-know is limited to the USAF version(s) of the A-12.' In a hand-written note adjacent to where Jack Ledford was to sign his approval for the document, he wrote 'Prepare but do not execute. Question of surfacing is still in doubt.'

A curt top secret memo dated 20 May 1963 (reflecting the friction between the OSA and NRO at the time) addressed to Director, National Reconnaissance Office (Brockway McMillan) and written by Herbert 'Pete' Scoville (CIA, Deputy Director for Research), entitled *Proposal for Surfacing an LRI* [Long Range Interceptor] *Prototype as Cover for the Oxcart Programme*, noted in point three:

> The purpose of this memorandum is to restate the grave concern expressed in our previous

> memorandum with regard to the possibility of an untoward incident which could result in an uncontrolled surfacing of the Oxcart vehicle. Since that paper was written, there have been several minor incidents involving mechanical malfunctions and sightings of the A-12 which might have developed into serious problems had fortune not otherwise dictated. In addition, during this period, escalated activity in the R-12 [SR-71] procurement programme has, as we anticipated, generated increasing speculation both in the industry and in the Air Force regarding many facets of the programme.

In point four, the final paragraph, Scoville continued: ‘In light of the foregoing, I feel that it is not only appropriate but essential at this time to request a reconsideration of this problem by the National Reconnaissance Office (NRO) with a view toward making recommendations to the Ad Hoc Cover Committee and higher authorities as to whether we should continue with the current contingency plan or take action to implement the proposed LRI surfacing.’ This contentious issue needed to be resolved. Undoubtedly Scoville’s tenacity ensured that minds remained focused on the problem at hand, and, sure enough, things began to move; the first stage was the transfer of all management functions relating to Program D (which had taken on the AF-12) and the R-12 to the Air Force. This brought with it a change in security. Another secret memo, dated 11 July 1963, addressed to Eugene Zuckert, Secretary of the Air Force and penned by Gen Schriever, Commander US Air Force, noted, ‘The change in security would publicly disclose (2d level) the existence of the development of the AF-12 and/or R-12.’

But concerns continued, as witnessed in point 10 of a classified CIA diary note dated 27 September:

> At the executive meeting this morning the Director reported that Mr Hotz, the editor of *Aviation Week*, had been to see General Carroll. He told General Carroll that he had good information that another airplane, a follow-up for the U-2, had been developed. Carroll apparently told Hotz that it would not be in the national interest to print anything on this, in response to which Hotz said that he was willing to sit on it provided everyone else did. In other words, he was not about to be scooped. The Director is seriously concerned that Oxcart is going to blow sooner or later.

On Friday 29 November 1963 (one week after the assassination of President Kennedy) the new president, Lyndon B. Johnson (LBJ), convened a meeting of the National Security Council (CIA Director John McCone, SecDef Robert McNamara, SecState Dean Rusk, Special Assistant McGeorge Bundy and FAA Chief Najeeb Halaby). The main question on the agenda was whether to, or how to, ‘surface’ the technological triumph of Oxcart. McCone counselled delay, but was in favour of some sort of press release in connection with the planned development of a supersonic transport (SST) airliner; Halaby agreed. McNamara was in favour of total exposure because the money already allocated to Oxcart would weaken the case for funding the B-70 programme and other expensive Air Force projects that he did not like.

At that point, Lyndon Johnson was informed by Bundy that Kennedy had been opposed to the early release of information pertaining to Oxcart, preferring instead to hold off its public debut until the following year so as to strengthen his re-election campaign. Bundy was attuned to the politics of 'high-tech projects' and spoke against early release because of potential criticisms likely to be levelled at the new president for attempting to make political 'capital' out of a great intelligence secret. Consequently, LBJ decided to 'keep his powder dry' until the run up to the 1964 elections. However, after Republican candidate Senator Barry Goldwater accused the Democrats of failing to sponsor new aircraft projects, Johnson concluded that the earlier-than-planned release of some form of statement was inevitable, and directed his advisors to prepare a formal announcement about the hitherto black project. Kelly was asked to work on the draft that LBJ would use, and noted in his diary on 25 February that he 'proposed the terminology "A-11" as it was the non-anti-radar version.'

BACK AT AREA 51

While all this politicking was taking place in far-away Washington DC, Jim Eastham and flight test engineer John Wallace got airborne in 60-6936 for another test sortie. The date was 3 February 1964, and this time the test card directed that they should complete the very first heat soak of a Blackbird. To achieve this, the flight was to be conducted at Mach 3.16 for precisely 10 minutes.

The test procedure was followed to the letter, but on recovery back at The Ranch, an inspection revealed that due to an error in the pitot static system, Jim had exceeded Mach 3.2. Consequently, the aircraft had encountered considerably higher stagnation temperatures, which had damaged practically all the electrical wiring. It would be several months before '936 would fly again, and during the intervening period events on Capitol Hill caught up with the programme.

On 29 February 1964, just four days after Kelly's diary entry concerning his work on a draft statement, President Johnson made the following announcement:

> The United States has successfully developed an advanced experimental aircraft, the A-11, which has been in sustained flight at more than 2,000mph and at altitudes in excess of 70,000ft. The performance of the A-11 far exceeds that of any other aircraft in the world today. The development of this has been made possible by major advances in aircraft technology of great significance to both military and commercial applications. Several A-11 aircraft are now being flight-tested at Edwards Air Force base in California.
>
> The existence of this programme is being disclosed to permit the orderly exploitation of this advanced technology in our military and commercial planes. This advance experimental aircraft, capable of high-speed and high-altitude and long-range performance at thousands of miles, constitutes the technological accomplishment that will facilitate the achievement of a number of important military and commercial requirements. The A-11 aircraft now at Edwards Air Force base are under extensive tests to determine their capabilities as long-range interceptors. The development of supersonic commercial transport aircraft will also be greatly assisted by the lessons learned from this A-11 program. For example, one of the most important technological achievements in this project has been the mastery of the metallurgy and fabrication of titanium metal which is required for the high temperatures experienced by aircraft travelling at more than three times the speed of sound. Arrangements are being made to make this and other important technical developments available under appropriate safeguards to those directly engaged in the supersonic transport programme.

An 818lb AIM-47 is gently raised into a weapons bay. (Lockheed Martin via Tony Landis)

> This project was first started in 1959. Appropriate members of the Senate and House have been kept fully informed on the programme since the day of its inception. Lockheed Aircraft Corporation, at Burbank, California, is the manufacturer of the aircraft. The aircraft engine, the J58, was designed and built by the Pratt & Whitney aircraft division, United Aircraft Corporation. The experimental fire-control and air-to-air missile system for the A-11 was developed by the Hughes Aircraft Corporation.
>
> In view of the continuing importance of these developments to our national security, the detailed performance of the A-11 will remain strictly classified and all individuals associated with the programme have been directed to refrain from making any further disclosure concerning this programme.
>
> I do not expect to discuss this important matter further with you today but certain additional information will be made available to all of you after this meeting. If you care, Mr Salinger will make the appropriate arrangements.

Kelly noted in his diary, 'Pres. Johnson announced the AF-12. Twenty minutes after he did this, we flew the two birds from the Area to Muroc.' The two flyable aircraft, 60-6934 and 60-6935, were positioned to Edwards AFB (which had been known as Muroc until the late 1940s) by Lou Schalk and Bob Gilliland, and the event was witnessed by just a few dozen maintenance staff who happened to be at work that Saturday morning. Lou Schalk remembers taxiing to the assigned hangar as eyes bulged and heads turned in utter disbelief at the sight of the two sleek aircraft, the like of which hadn't been seen before by anyone outside the programme, with the possible exception of a few desert dwellers and incredulous airline crews.

Lou continues,

> Our supposed low-key, rather laid-back positioning flight lost a touch of elegance when, to aid push-back into the hangar, we turned the aircraft through 180° at the entrance. This turn-around manoeuvre sent hot engine exhaust gases into the hangar that caused the overhead fire extinguisher valves to open. These valves were big – like the flood valves on the hangar decks of aircraft carriers. The desert hadn't seen so much water since Noah's embarkation!

Article 1001 undertakes air-refuelling tests early in the flight-test programme. (Lockheed Martin via Tony Landis)

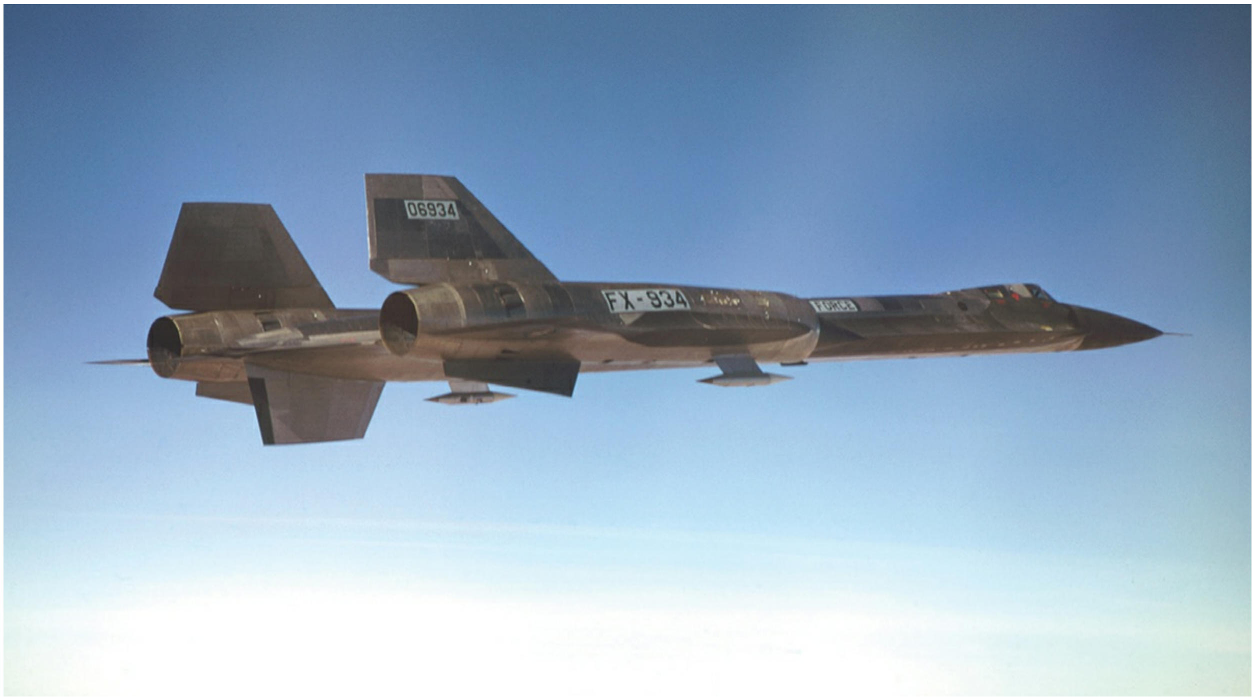
Once its re-wiring work had been completed, aircraft 60-6936 joined its two stablemates at Edwards and the now overt programme continued in a totally new environment. Suddenly, it appeared the US Air Force had virtually matched, man-for-man, all the contractors involved on the programme and it began to look to the civilian test force that the Air Force was trying to take over the entire project. In addition, the move also caused logistical headaches, as most of the expertise was still based at Area 51.

In Burbank, Kelly had similar concerns, when he wrote in his diary on 28 May 1964, 'Today I talked to Henry Combs, Ed Martin, and briefly to Dick Boehme and Rus Daniell, to try to avoid having the Skunk Works develop into two distinct organizations. We are beset by military people and have now reached a point where we have half as many people writing manuals as we used to design the A-12. Still fighting the battle hard to prevent being forced into standard procedures.'

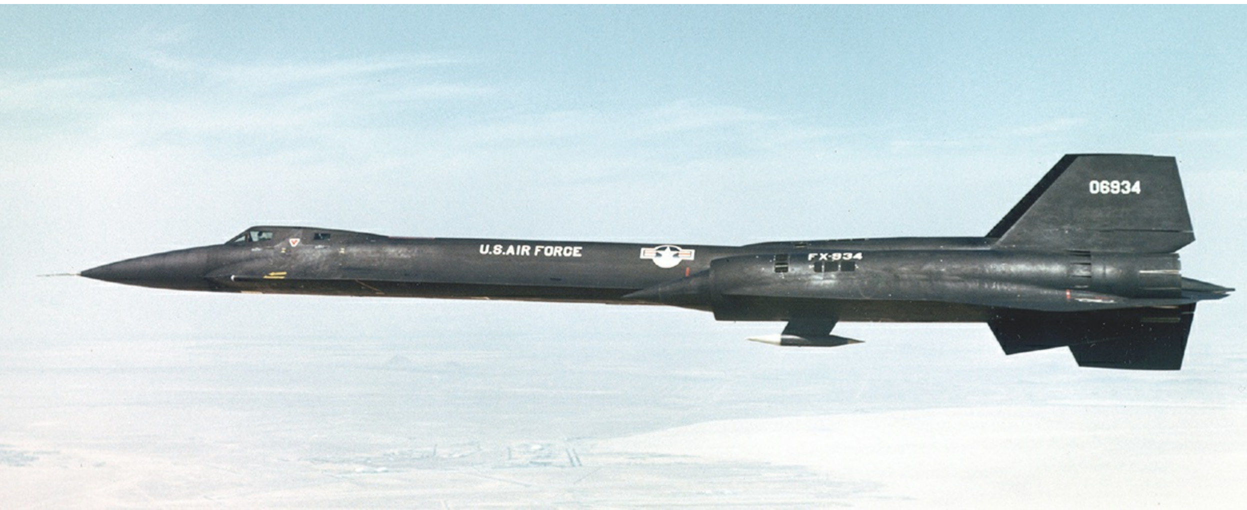
Notwithstanding these 'ripples on the mill pond', the first order of business shortly after arriving at Edwards was to install and make operational the new, electrically controlled air inlet system. Once installed, it took Jim Eastham just three months to complete the envelope expansion programme.

Jim flew all of these flights in the Lockheed-operated prototype, 60-6934. On the first, a minor problem occurred as the aircraft approached its design speed of

Mach 3.2, which resulted in a directional oscillation. This discrepancy was noticed immediately and acceleration terminated. On return to Edwards, the cause was found to be instability in the inlet controls; as the aircraft yawed in one direction, both spikes reacted to the change as a function of the Beta angle. With the problem identified, Jim attained design speed during the next flight.



60-6934 showing the extended centreline ventral fin Note the streamlined camera fairings on the underside of each nacelle; the cameras recorded missile separation imagery. (Lockheed Martin via Tony Landis)



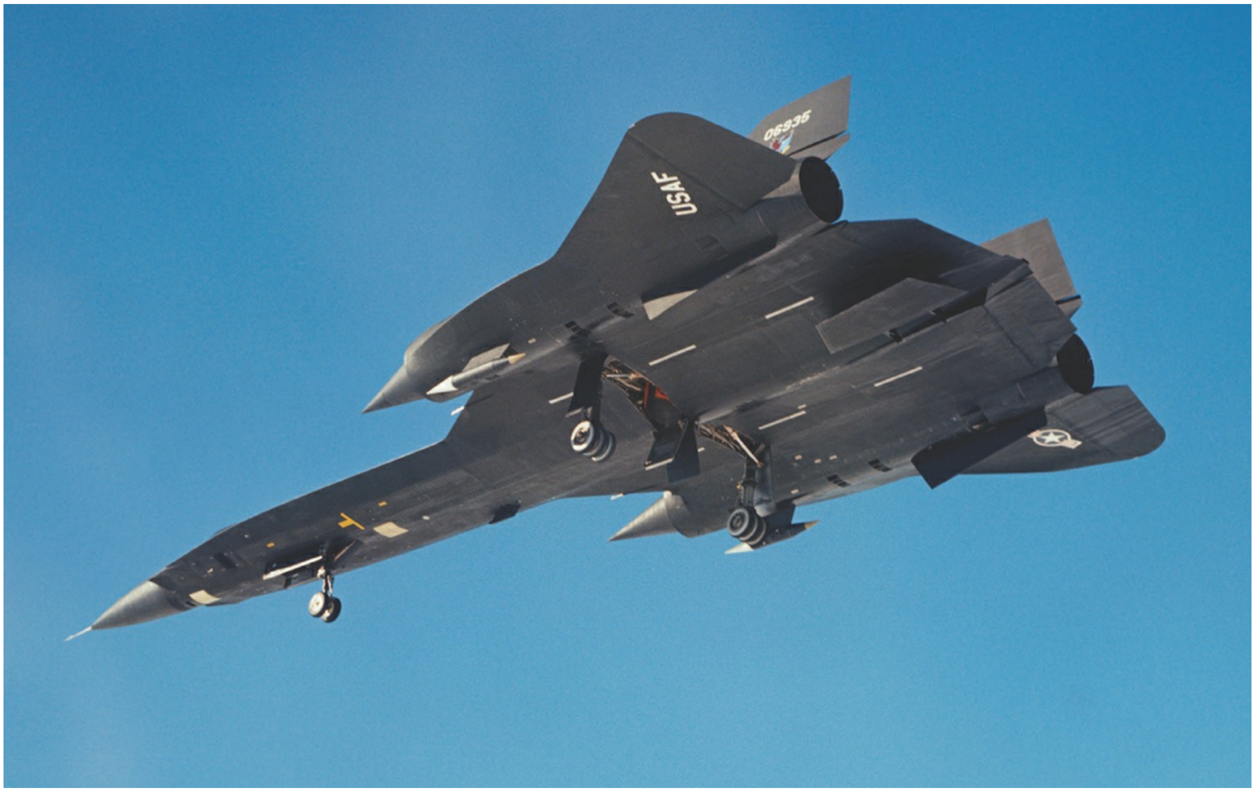
60-6934 resplendent in its newly applied black paint scheme, which reduced thermodynamic heating of the aircraft's skin by some 20 per cent. (Lockheed Martin via Tony Landis)

In April 1965, Jim Eastham flew a number of profile-proving sorties that would later allow Air Force crews to fly the YF-12 into the record books. By no means a coincidence, the date chosen to establish these records was 1 May 1965, five years to the day that Francis Gary Powers had been shot down by a Soviet SA-2 missile. In this very public manner the United States was able to aptly demonstrate that over the intervening period it been far from asleep and that it once again ruled the skies. Colonel Robert L. 'Fox' Stephens flew YF-12A 60-6936 to a new absolute altitude record of 80,257ft (24,390m), and Col Walter Daniel took the absolute speed record over a 500km closed course and also obtained the 1,000km closed course record (see Appendix 11 for further details).

On 1 June 1965, the joint SR-71/YF-12 Test Force was formed at Edwards. Comprising Lockheed and Air Force personnel, it was re-designated as the 4786th Test Squadron on 16 June 1970.

Lockheed test pilot Bill Weaver found himself in the unenviable position of flying a YF-12 with a ventral fin that stubbornly refused to retract. Demonstrating great piloting skill and determination, he successfully landed the aircraft and saved an extremely valuable piece of hardware – but the fin's profile was considerably modified by the incident.

With much of the 'pick and shovel work' completed in the YB-58, the ASG-18 and the GAR-9 missile were quickly integrated into the YF-12, where the system transcended its predicted performance figures, although the highly instrumented test aircraft never carried a full missile load.



Article 1002 (60-6935) on approach to Edwards AFB. With the landing gear extended, the ventral fin has folded to provide ground clearance. Note the Aerospace Defense Command insignia on the tail. (USAF via Tony Landis)

During the first missile separation test, on-board cameras showed the missile incorrectly aligned; had the rocket motor ignited, the missile would probably have ended up in the forward cockpit! Adjustments were made and the remainder of the test programme proceeded extremely well. Approximately 12 missile firings were made from the YF-12, seven by Jim and the remainder by Air Force crews. An indication of the system's operational potential can be gauged from a test flight on 25 April 1966, in '934 from Eglin AFB, Florida, over the Gulf of Mexico, as Jim Eastham now recalls:

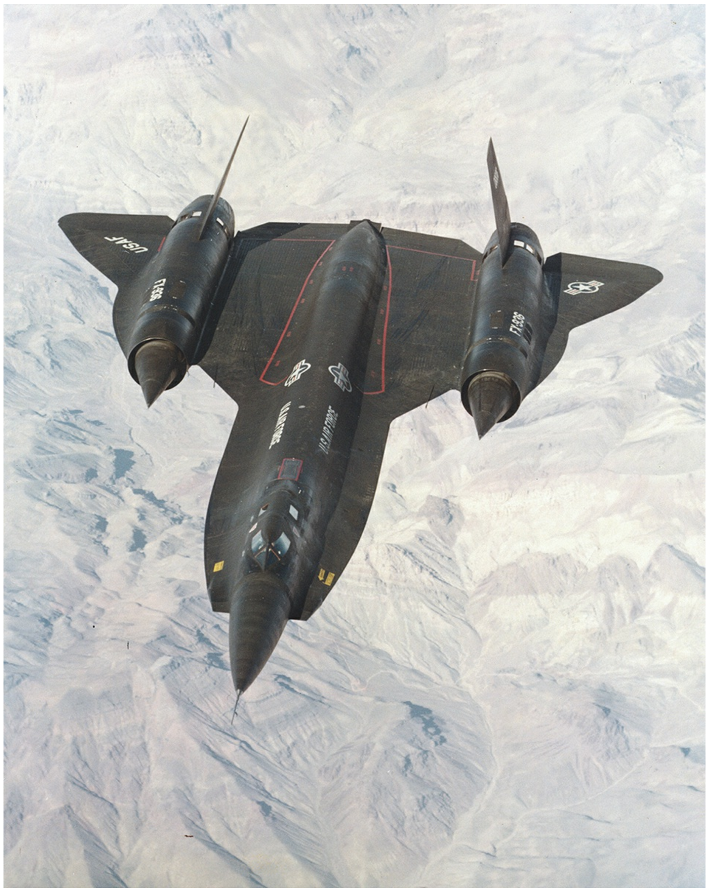
> Following take-off, we accelerated in a general southwest direction and made a right turn on to an eastbound heading for the 'hot run'. George Parsons, my FCO, acquired the target, which was at about 1,000ft, Mach 0.6 and heading west at a range of 130nm. At that time we were at Mach 3.2 and 75,000ft. Even though we were being vectored, we also ran the mission using the modified close-control feature of the ASG-18 weapon system and tracked the target at the exact 12 o'clock

> position. Our closure rate was Mach 3.8 and essentially we had an altitude differential of 75,000ft! We went through the mission prep stage and the launch was made at approximately 53nm. The missile guided to impact on the left horizontal stabilizer of the QB-47. At the time of impact we were looking down 73° at the target!

The unarmed missile hit and destroyed approximately 4ft of the B-47's tailplane. It seems that all but one of the seven launches made by the Lockheed crew were deemed to be a success – the failure of one of the sorties was attributed to a missile gyro system failure. Perhaps not surprisingly, the Air Force was extremely impressed. Aerospace Defense Command (ADC) calculated that it would require 96 of the big fighter's production version – designated F-12B – to replace its aging fleet of F-102 and F-106 interceptors.

With a force this size, ADC officials were confident that they could provide protection to the entire United States against incoming high-speed, low-level bombers by stationing three squadrons of 16 aircraft each on the east coast at Otis AFB, Maryland and another three squadrons of 16 at Paine AFB, Washington to protect the west coast. Another important facet of the F-12B was its re-attack speed, which was much faster than for example the Convair F-106, which required double the time to reposition itself on a subsonic bomber compared with the F-12; in the case of a supersonic bomber, the F-106's time requirement was four times greater. But it was not to be. Instead, political shenanigans and a long-simmering feud over the appropriation of defence funds between the SecDef, Robert McNamara, and the Air Force deteriorated into a bitter fight.

The war of words between the Air Force and its political masters had begun in April 1964, when the head of ADC, Gen Herbert B. Thatcher, said that he would like to have a large IMI fleet operational by 1967. The root of these comments was engrained in his observations that the DoD had decided not to proceed with such a programme despite giving the impression that such a development was under way via the YF-12A. In truth, McNamara preferred the F-106X proposal after a national intelligence estimate showed it to be the most cost-effective answer to the predicted Soviet bomber threat. As a result, on three separate occasions over three years, he took the unprecedented step of actually denying the Air Force access to $90 million worth of funds that had been appropriated by Congress to begin F-12B production.



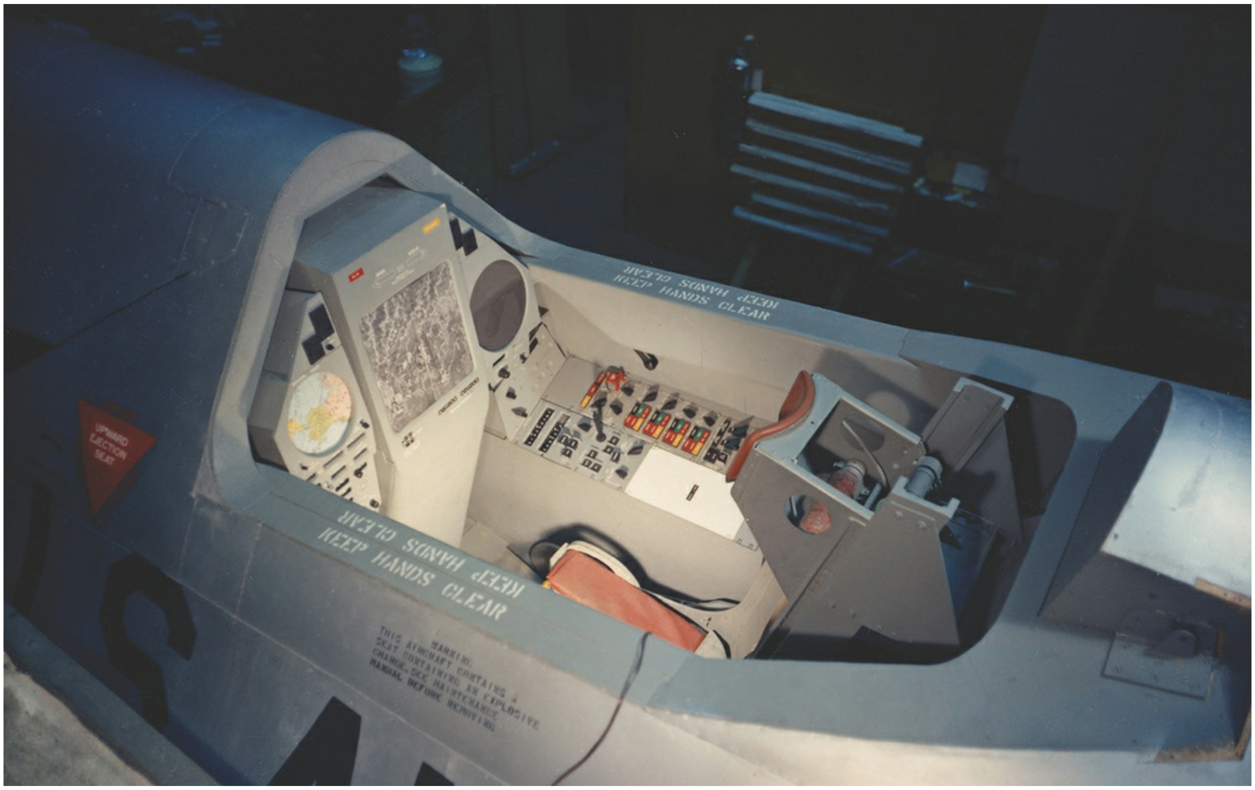
First flown on 13 March 1964, Article 1003 (60-6936) was photographed here over the Rockies. The cut-back chine modification to accommodate the radome is readily apparent. (Lockheed Martin via Tony Landis)

These two frame-grabs from test flight film taken from the YF-12's externally mounted cameras capture the moment when one of the 818lb AIM-47 missiles is punched clear of the aircraft, followed by its rocket motor firing and the missile accelerating off to its target. (Lockheed Martin)

AFSC-operated JQB-47E 53-4256 had been with the 3214th Operational Maintenance Squadron (OMS) at Eglin AFB before being placed in storage at Davis Monthan AFB on 20 August 1968. Mission markings on the aircraft's nose indicate three missions against Kedlock. (Norman Taylor via Tony Landis)

Questioned during a joint hearing of the Senate Armed Services Committee and Appropriation Defence Sub-Committee, McNamara said, 'I feel quite confident that it is not necessary to appropriate money that can't be justified for the weapon system itself simply to keep the production line open.' These flagrant delaying tactics undoubtedly protected funds earmarked for the B-70 bomber and the F-106X (the latter programme eventually producing the superlative F-15 Eagle).

Consequently, in July 1966 Kelly was directed to 'give up further flying of the YF-12As'. Things continued to deteriorate and on 5 August 1966 Kelly noted in his log, 'We have laid off half of our test crew on the YF-12A and are maintaining only enough people to store the airplane or send it to Burbank. We are very near the end of this program.'

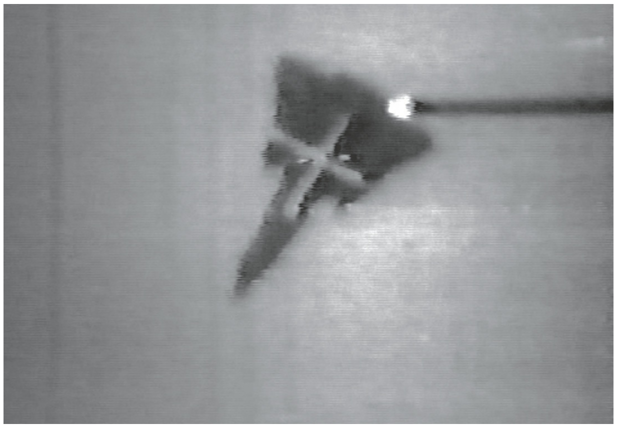


Full-scale mock-up of the F-12B's rear cockpit – SecDef Robert McNamara ordered its cancellation and that all jigs should also be destroyed, thereby ensuring the aircraft could never be resurrected. (Lockheed Martin)

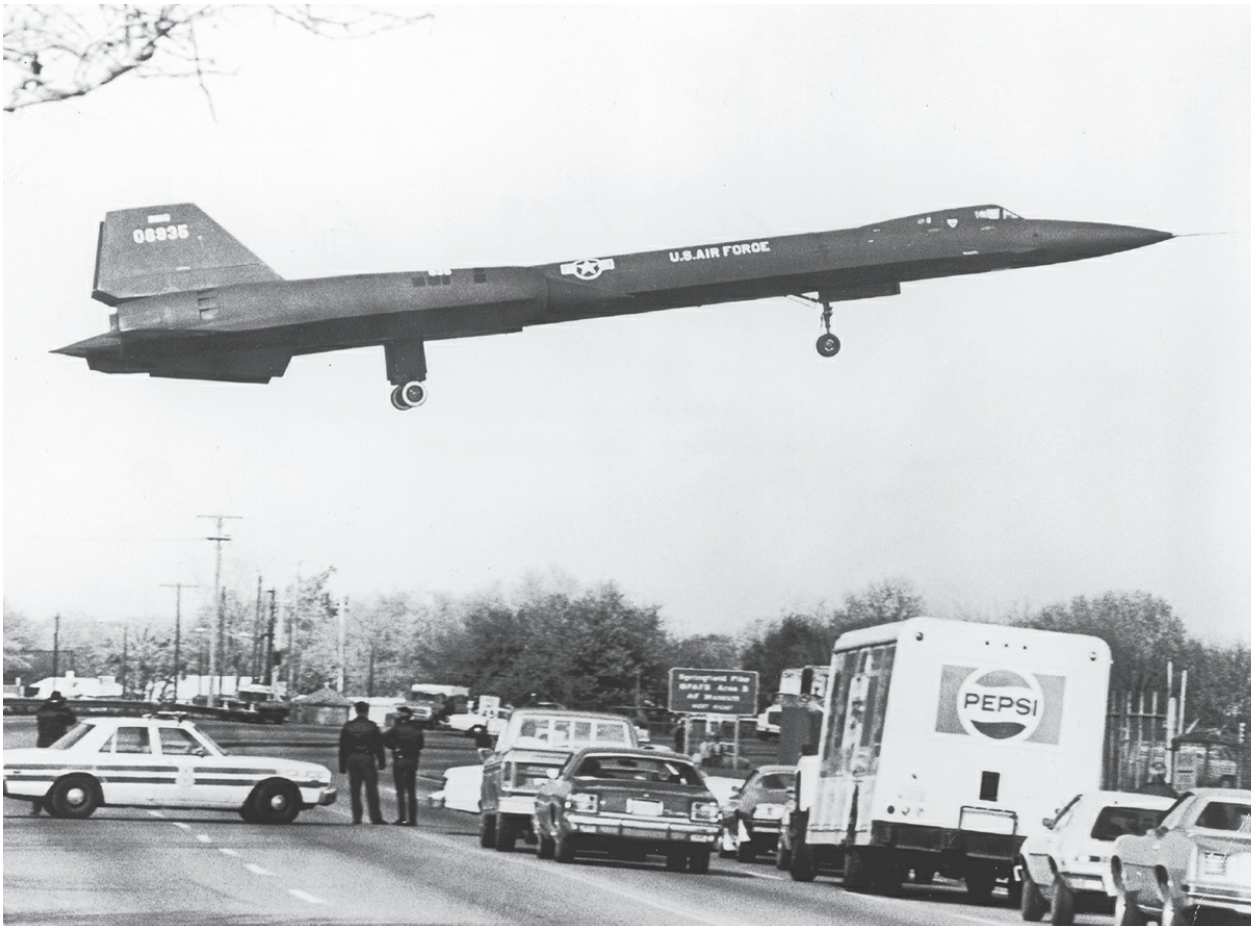
Despite this rather bleak outlook, Kelly still remained hopeful that F-12B production would be reinstated, and even as late as 27 January 1967 he was still awaiting a final decision from the Air Force. In March of that year, Kelly's optimism seemed justified when Colonel Ben Bellis led him to believe that the F-12B proposal had been accepted by the Air Force. On 13 November 1967, Kelly was asked to carry out studies into converting the ten now retired Oxcarts and also ten SR-71s into fighters. These studies envisaged the installation of Sparrow missiles and a Westinghouse radar, but nothing further came of this.

In late December Kelly received a call from the SPO instructing him to shut down all AF-12 studies immediately and cancelling all other ADP air defence programmes with the exception of a vulnerability study that was to be transferred to the SR-71. On 5 January 1968, the Skunk Works received official notification from the Air Force, closing down the F-12B. The YF-12A programme formally ended on 1 February. This was followed up four days later by a letter from the Air Force instructing Lockheed to destroy all A-12/F-12 and SR-71 tooling. Consequently the large jigs were cut up and duly sold for scrap at 7.5cents per lb. As Kelly noted in his log, 'Ten years from now the country will be very sorry for taking this decision of stopping production on the whole Mach 3 series of aircraft in the USA.'

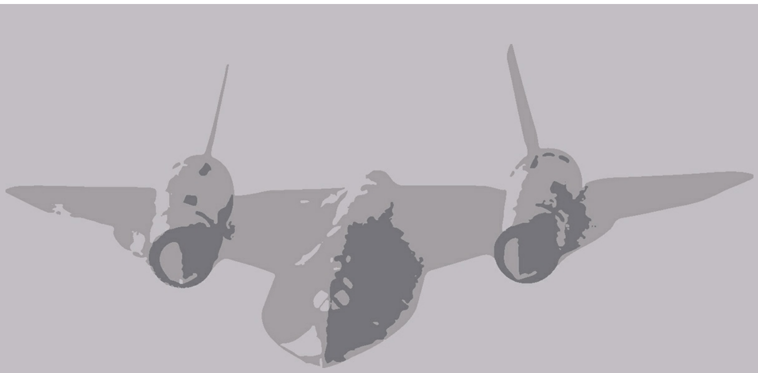
With the programme cancelled, all three YF-12As were placed in storage at Edwards, but this was not quite the end of the story. The loss of SR-71B '957 prompted an interesting piece of aviation surgery. After ablation of its fuselage forebody, the rear section of YF-12A Article 1001 was grafted to the front fuselage of an SR-71 static test specimen to create 'The Bastard', 64-17981. This so-called SR-71C replacement trainer first flew on 14 March 1969. Three test flights were made in two days before the aircraft was delivered to Beale, where it was used as a stand-in whenever the surviving trainer, '756, was undergoing Periodic Depot Maintenance (PDM).



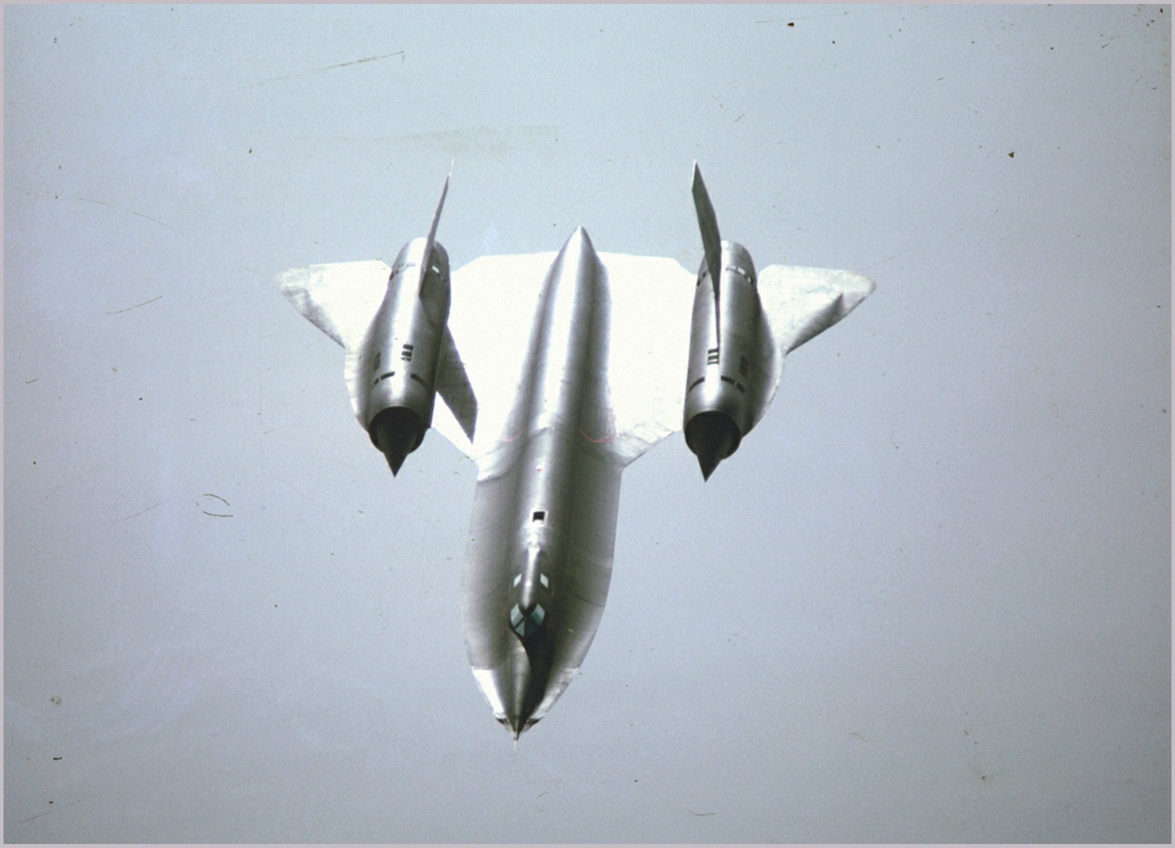
This poor-quality image is a frame-grab from the powerful ground-based tracking cameras at Edwards that videoed the right engine fire and subsequent loss of YF-12A 60-6936 on 24 June 1971. Note the large white cross that was applied to the aircraft's underside when it secured a number of world absolute speed and altitude records some six years earlier. (USAF via Tony Landis)


06935
U.S. AIR FORCE
PEPSI

With Kedlock cancelled, 60-6935 was delivered to Wright-Patterson AFB for permanent display. It remains at the USAF Museum as the only surviving example of its type. (Lockheed Martin)



CHAPTER 9: TECHNICAL



The unmistakable planform of the SR-71 was characterized by its aft-body delta wing, two large engine nacelles and forward fuselage chine. Also note the conical camber applied to the outboard wing sections. (Paul F. Crickmore)

The ambitious nature of Oxcart cannot be overstated. When E. M. Land of the Polaroid Corporation presided over those six historic meetings between 1957 and 1959 that led to the A-12, the best frontline fighters of the day were the early century-series jets, like the F-100 Super Sabre and F-101 Voodoo.

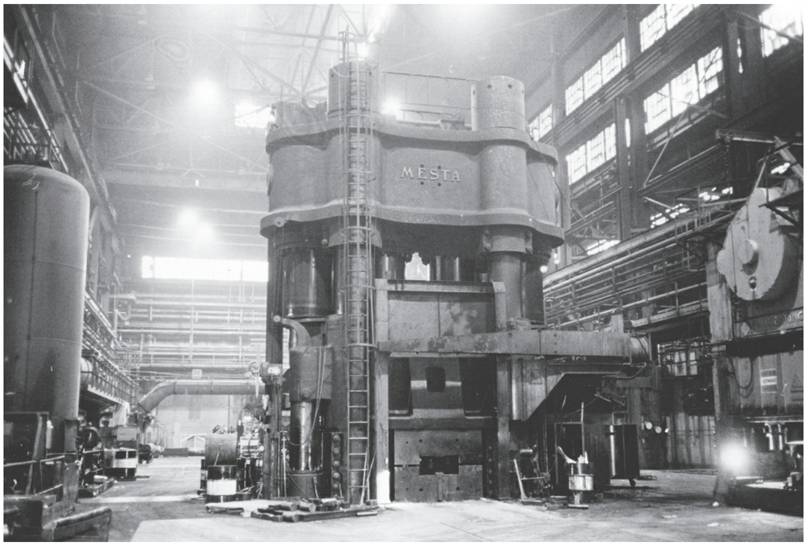
In a single bound, it was proposed that the A-12 would operate routinely at double the altitude and treble the speeds of those contemporary fighters. Therefore, its designers and engineers had to master not only the many daunting problems associated with high-altitude, high-Mach flight. They also had to employ the latest techniques and materials to reduce the A-12's RCS to produce what can now be regarded as the world's first operational stealth aircraft.

In an incredible feat of engineering brilliance, Lockheed's Skunk Works matured the A-12 into a frontline reconnaissance gatherer. They also ran three other evolutionary programmes, to create the D-21/M-21 combination, the YF-12 and SR-71, from essentially the same airframe. There was a high degree of component commonality applicable to all four variants of the 'Blackbird family', but for clarity's sake, the following applies specifically to arguably the most significant member of the family, the SR-71.

GENERAL LAYOUT

The exterior of the SR-71 was characterized by an aft-body delta wing with two large engine nacelles, each mounted at mid-semi-span. Two all-moving fins were located on top of each nacelle, canted inboard 15° from the vertical to reduce the aircraft's radar signature and aid in controlling excess offset yaw during single-engine flight. A large, aft-moving inlet spike or centre-body protruded forward from each engine nacelle, used to regulate mass airflow to the Pratt & Whitney J58 engines.

Mission sensors were housed in a detachable nose section and in equipment bays located in the underside of the chine (a boat-like hull-form) that extended along both sides of the long fuselage forebody. The aircraft was flown by a pilot and reconnaissance systems officer (RSO), wearing full pressure suits and sitting in tandem.



A 50,000-ton press, developed and built by Wyman Gordon, was used in the manufacture of the main nacelle rings. (Lockheed Martin)

Initially nacelle rings were made from 30 parts and required 487 hours to assemble. As shown here, they were later manufactured from a single forging weighing 325lb and then machined on advanced profilers that enabled the part to be finished in 150 hours. (Lockheed Martin)

The wing was arranged in box sections, one outboard of the engine nacelle and two inboard. The inboard sections were positioned one forward and one aft, and were separated by a 1m-wide compartment housing the main gear bay. The front and rear beams of the inboard box sections provided support for the main gear.

The outboard wing leading edge featured 5° of conical camber. Conical camber is the twist in the wing that reduces as you reach the wing tips. This means that the wing's angle of attack is less at the wing tips than when closer to the fuselage. This results in the outer part of the wing producing less lift than the inboard section which means that the aerodynamic wing load is carried closer to the fuselage rather than at the furthest points. It also means that the ailerons, or in the case of the SR-71 the elevons, are at a lower angle of attack and will be further from stalling, thereby remaining effective for roll as the inboard wing approaches stall.

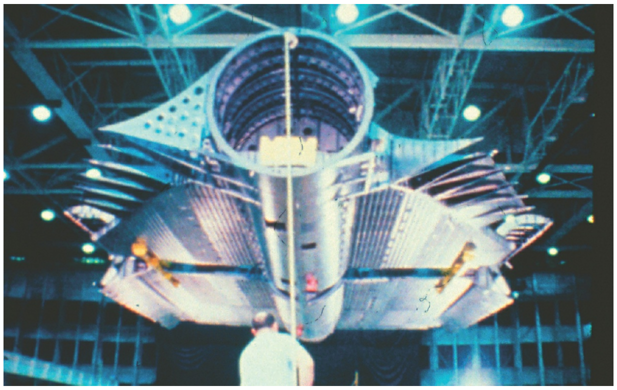
The thin, biconvex wing had a leading-edge sweep of 52.62° and a trailing edge forward sweep of 10°; it joined the mid-fuselage with a slight negative incidence. The aircraft's loaded gross weight varied from between 135,000 to more than 140,000lb and zero fuel weight varied from 56,500 to in excess of 60,000lb.

The fuselage can be described in three sections. First the forebody: since the nose section was interchangeable for mission flexibility and structurally independent of the fuselage, the forebody can be said to extend from the tip of the forward cockpit to a point perpendicular to the intersection of the leading edge of the wing, a point known as fuselage station 715. The structure consisted of a ring-stiffened cylinder fitted with longerons at the top, bottom and side, and modified to the extent necessary to accommodate the cockpit, equipment compartments, nose gear well, air refuelling receptacle and two fuel tanks.

The aft and mid-fuselage section is moved by crane to an area where the forward and aft inboard wing sections will be attached. (Lockheed Martin)

The mid-section, which extended to the main undercarriage well, contained fuel tanks that stretched laterally into the forward wing box area. The main gear bay dissected the forward and aft wing boxes and formed two structurally independent elements. Inboard, aerodynamic and bending loads at the root were carried by the fuselage longerons located at the top and bottom of the centreline, whereas outboard loads were borne by the wing attaching structure.

The aft fuselage section began at the rear of the main gear bay and tapered into the tail, but excluded the brake 'chute receptacle. The entire area, together with the aft wing section, was used to provide two more large fuel compartments. To reduce trim drag at high Mach numbers, the nose section canted upwards some 2 ½°. Fuselage structural rigidity was enhanced by the use of ring stiffeners, while fairings fitted between the fuselage and wing root, although not part of the structure and supporting local air-loads only, provided a convenient cavity within which to house electrical and plumbing lines.



A 1m-wide gap between the two inboard wing sections accommodates the main undercarriage. (Lockheed Martin)

An inherent aerodynamic design characteristic of delta-winged aircraft resulting from their large root chord is a major rearward shift of the centre of pressure (COP) during acceleration from subsonic flight. This results in the pilot having to apply an increasing amount of drag-inducing elevon to trim the aircraft and reduce the pitch moment.

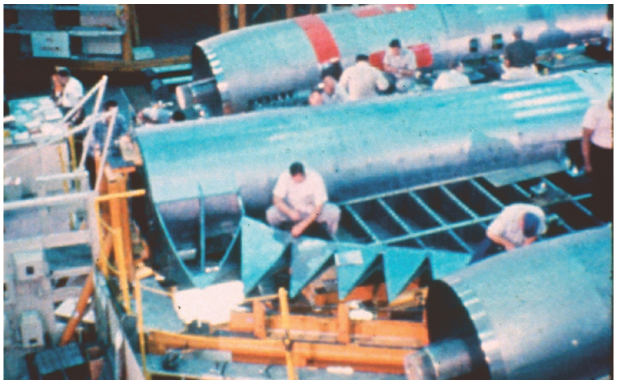
A key aerodynamic asset in reducing trim drag in the SR-71 was its chine. With the fuselage forebody accounting for 40 per cent of the aircraft's overall length, the chine acted as a fixed canard surface, producing lift as a function of the square of its speed, thereby becoming more effective with increasing Mach number. This, when combined with the long moment arm of the forebody in relation to the centre of gravity, greatly reduced the rearward translation of the COP, which in turn reduced the amount of elevon necessary to balance these forces and so reduced trim drag.

The chine presented a streamlined profile to airflow in a side slip and allowed the use of smaller vertical surfaces to maintain directional stability. The elevated rear cockpit in the SR-71B trainer was destabilizing and a ventral fin was installed under each nacelle on the SR-71B to restore directional stability. The maximum lift/drag ratio at subsonic speed was approximately 11.5 and at Mach 3 it was 6.5.

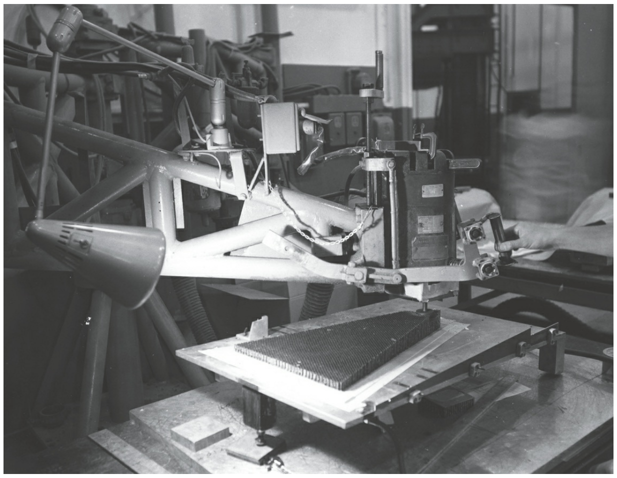
MATERIALS

In the near-vacuum conditions at 83,000ft, the ambient air pressure is about 0.4psi and the temperature hovers around -55°C. However, cruising in afterburner at its design speed of Mach 3.2 – covering a mile every 1.8 seconds (faster than the muzzle velocity of a 30-calibre bullet) – there remained enough air resistance to send the SR-71's airframe temperatures rocketing. External to the cockpit areas, these registered 220°C, about the hottest setting on a domestic oven; wing leading edges became hotter than a household soldering iron and the outside nacelle areas adjacent to the afterburner section reached 560°C.

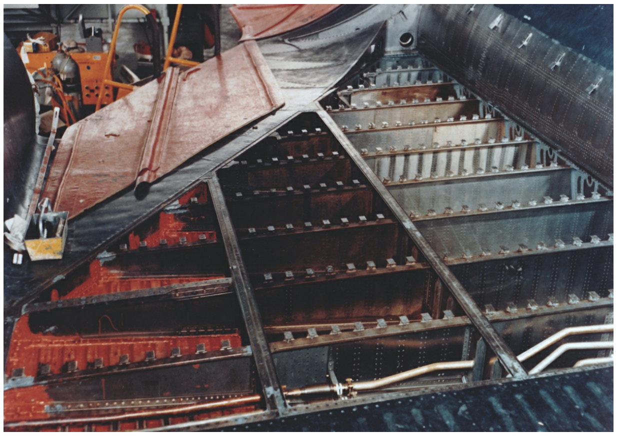
For this reason, thermodynamic factors influenced both design and construction of the SR-71 more than any other aircraft of its time. Only titanium and stainless steel could withstand operating in this 'thermal thicket', and as titanium weighs only half as much as stainless steel, 93 per cent of the SR-71's structural weight consisted of aged titanium B-120 alloy (B-120/Ti-13V-11Cr-3A1). The remaining seven per cent – the fins and triangular wedges that framed the outer edges of the aircraft – were of composite construction. Made from a mixture of asbestos and epoxy, they provided high-temperature, radar absorbent characteristics to reduce the aircraft's radar cross section (RCS).



The serrated titanium wing leading edges were designed to accommodate temperature-resistant RAM. (Lockheed Martin)



A monocoque wing fillet of RAM undergoing construction. (Lockheed Martin)



To attach thin titanium skin to heavier wing structure, simple stand-off clips were developed. These gave structural integrity while also providing a heat shield between components with very different expansion rates. (Lockheed Martin)

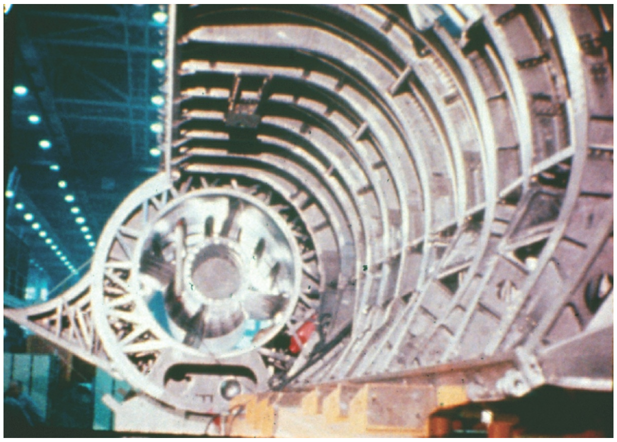
The next problem facing the Skunk Works team was from where to source the precious titanium. The CIA conducted a worldwide search and, after setting up a number of shell companies, surreptitiously purchased titanium sponge from one of the world's leading exporters – the Soviet Union! The subterfuge and circuitous supply routes were so successful that the Soviets never discovered that they were inadvertently supplying the material essential for constructing an aircraft that was being built specifically to spy on them!

The decision to use titanium represented a milestone in the continuing evolution of aviation materials and by necessity, led to the invention and perfection of many new airframe assembly procedures. Initially, the titanium age-hardening process required 70 hours to achieve maximum tensile strength (up to 200,000psi), but careful processing techniques by the Skunk Works reduced this to 40 hours.

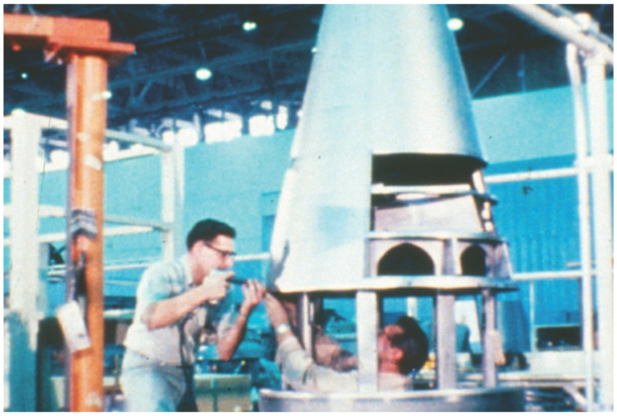
Over-aging titanium causes brittleness and some early coupons fell foul of this, shattering when dropped from desk height. Lockheed believed the problem to be hydrogen embrittlement, produced during the heat treatment process. However, despite the close cooperation of its supplier, Titanium Metals Corporation (TMC), the case remained unproven and unresolved until Lockheed replaced its entire acid pickling facility with a unit identical to that used by TMC.

A rigorous quality control programme was introduced. For every batch of ten or more parts processed, three samples became controls for the remainder. One was strength-tested to destruction, another tested for formability and the third held in reserve in case reprocessing should be required. With more than 13 million titanium parts manufactured, data was stored on all but a few early samples.

Titanium is a metal with several idiosyncrasies, and it wasn't long before the Skunk Works became well acquainted with all of them. For example, it is not compatible with chlorine, fluorine or cadmium. A line drawn on a sheet of titanium with a Pentel pen will eat a hole through it in about 12 hours; perhaps not surprisingly, all Pentel pens were called in off the shop floor. Early spot-welded panels produced during the summer had a habit of failing, while those put together in the winter lasted indefinitely. Through diligent detective work, it was discovered that to prevent the formation of algae in summer, the Burbank water supply was heavily chlorinated. Thereafter, all titanium parts were washed in distilled water. During prolonged heat soak tests, bolt heads began dropping off various installations; this, it was discovered, was caused by tiny cadmium deposits left after cadmium-plated spanners had been used to apply torque. Needless to say, all cadmium-plated spanners were removed from toolboxes.



A view from inside the left engine nacelle looking forward at the aft section of the inlet spike's body. (Lockheed Martin)



The inlet centrebody played a key role in the aircraft's propulsive system, helping regulate airflow throughout the entire flight envelope. (Lockheed Martin)

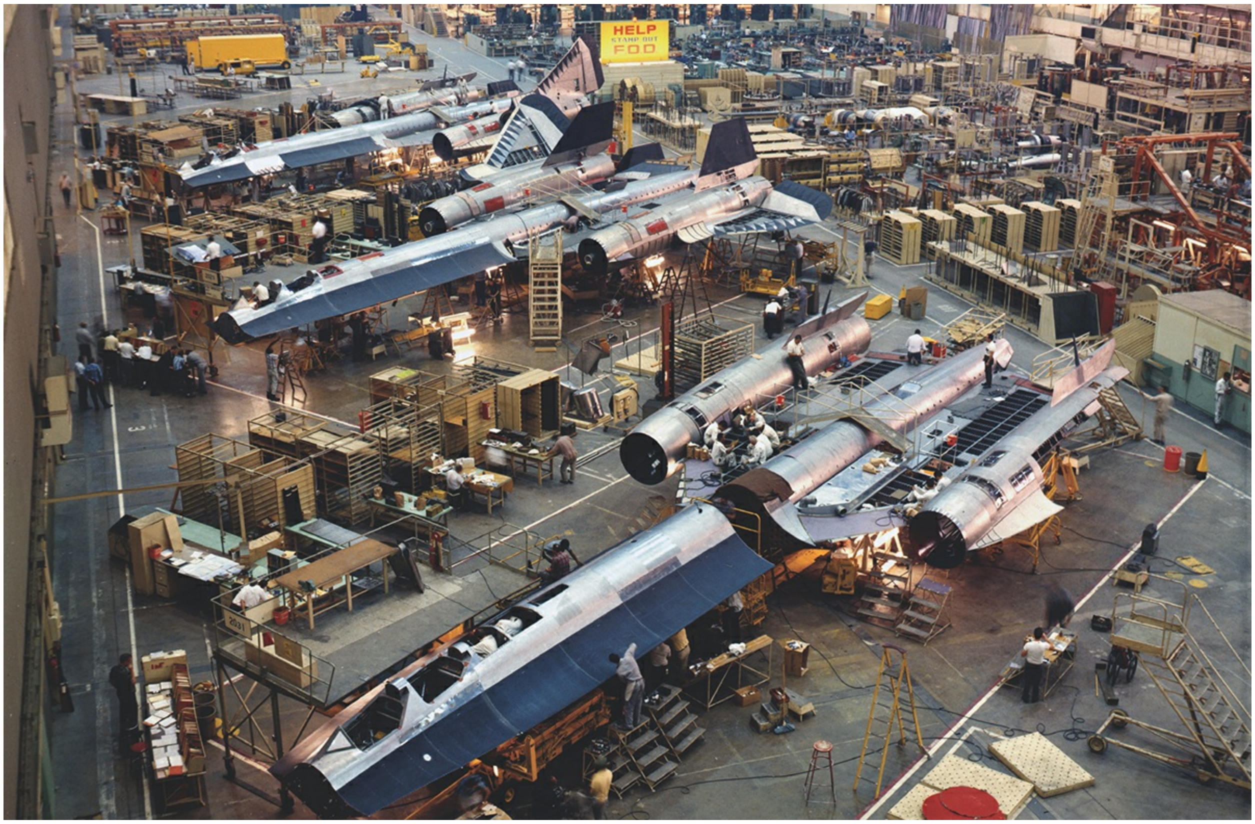
Lockheed awarded the Wyman Gordon Company a $1-million contract for a research programme into methods for forming complex structural pieces from titanium, such as the gear legs and engine nacelle rings. The result was a unique hot-forging process that used a 50,000-ton press to force the metal into the desired shape. Lockheed designed high-speed cutting tools that were then used to machine such items. Initially, a drill bit would cut just 17 holes in the hard metal before it was ruined, but by the end of the programme Lockheed ADP had developed drills that could bore 100 holes and then be successfully re-sharpened. The Skunk Works even developed a cutting fluid that, as well as eliminating the corrosive effects of many similar fluids, permitted metal removal at double the normal rates.

The worked parts were then 'pickled' (chemically descaled), to prevent them from going under-gauge in the acid baths, metal gauges two thousandths of an inch thicker than required for the final part were used. After cleaning, a pre-assembly inspection was carried out and the relevant segments assembled on spot-welding machines. To prevent oxidization, welding was conducted with the parts in a neutral nitrogen gas environment inside specially constructed chambers.

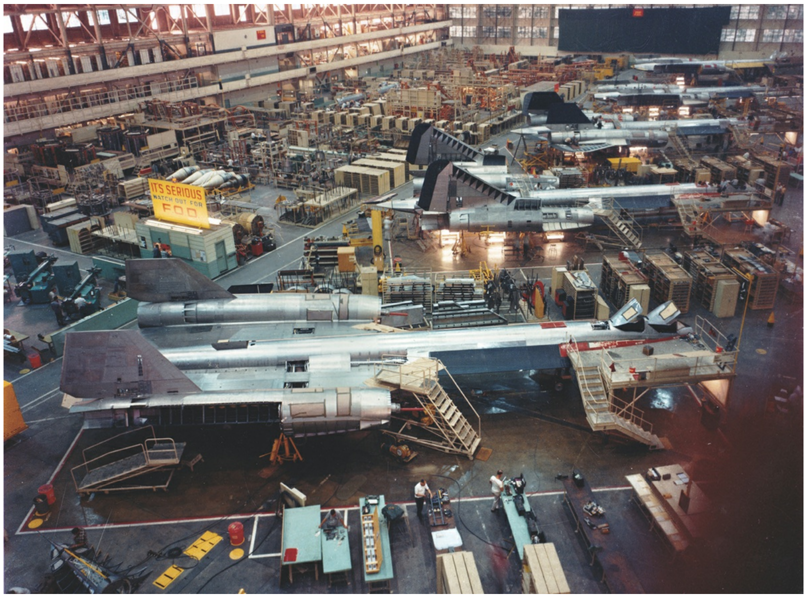
During a test undertaken to study thermal effects on large titanium wing panels, a sample 4ft by 6ft was heated to the computed heat flux expected in flight; it resulted in the specimen warping into a totally unacceptable shape. The problem was overcome by pressing chordwise corrugations into the outer skins; upon reaching the designed heat rate, the corrugations merely deepened by a few thousandths of an inch and on cooling returned to their original shape. Kelly commented at the time that some accused him of 'trying to make a 1932 Ford Trimotor go Mach 3', but the concept worked well.

Another thermodynamic challenge to overcome was that of differential heating across various parts of the interconnecting structure. For example, from a uniform start temperature of 27°C, eight minutes after acceleration a wing spar cap would reach 77°C, the spar web 102°C and the wing skin 177°C; it took another 16 minutes before all three components were within 8°C of one another. The problem was how to attach a thin sheet of titanium to much bulkier substructure, without the former buckling and tearing. As ever, the Skunk Works developed an innovative solution. In fact Kelly Johnson is attributed with coining the phrase 'Keep It Simple Stupid (KISS)': in this case, a standoff clip provided the anchor mechanism to the substructure, while also creating a heat shield between adjacent components. QED!

The SR-71 was painted black not to make it look sinister or menacing, but in an attempt to further reduce airframe temperatures. As stated in Kirchoff's law of radiation, a good absorber of heat is also a good emitter, and a good absorber is a black body.

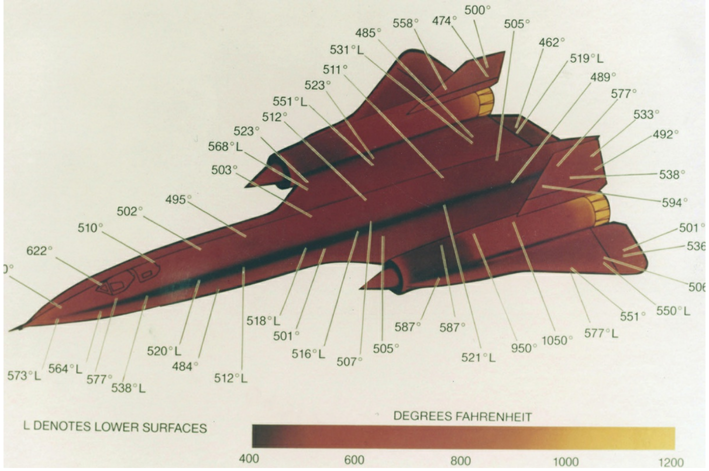


Inside the Burbank production facility, Article 2031 (61-7980) in the foreground is yet to be mated with the aft wing section at fuselage station (FS) 715. The outboard wing sections are also yet to be positioned. Directly behind Article 2031 is Article 2029 (61-7978). (Lockheed Martin)



Five SR-71s at various stages of completion; the aircraft in the foreground is probably Article 2001 (61-7950), the prototype. Note the titanium tail, which was later changed for composite units similar to those equipping the third aircraft from the camera. Note the various shapes of RAM (in black) used to reduce the aircraft's RCS. (Lockheed Martin)

Since convective heating decreases with increasing altitude and radiation is independent of height, it was useful to harness the radiation component when cruising above 70,000ft. Experiments demonstrated that black paint provided an emissivity value of 0.92 compared to 0.38 for bare titanium. It was estimated that its black 'overcoat' reduced airframe temperatures by between 15 and 30°C which it was felt was well worth the 60lb weight penalty imposed by painting the aircraft. Black also helped to reduce visual acquisition of the aircraft when cruising at the inky-black altitudes of near space over 'denied airspace'. Finally, suspended within the pigment were minute iron ferrite balls, to help dissipate electro-magnetic energy from radars, thereby also helping to reduce the SR-71's RCS.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L DENOTES LOWER SURFACES
DEGREES FAHRENHEIT
400
600
800
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1200

Thermal heating encountered at operational speeds and altitudes ruled out aluminium as the primary construction material. (Lockheed Martin)

Ben Rich was the Skunk Works' chief thermodynamicist and worked on all the Blackbird programmes. When Kelly Johnson retired in 1975, Ben succeeded him. (Lockheed Martin)

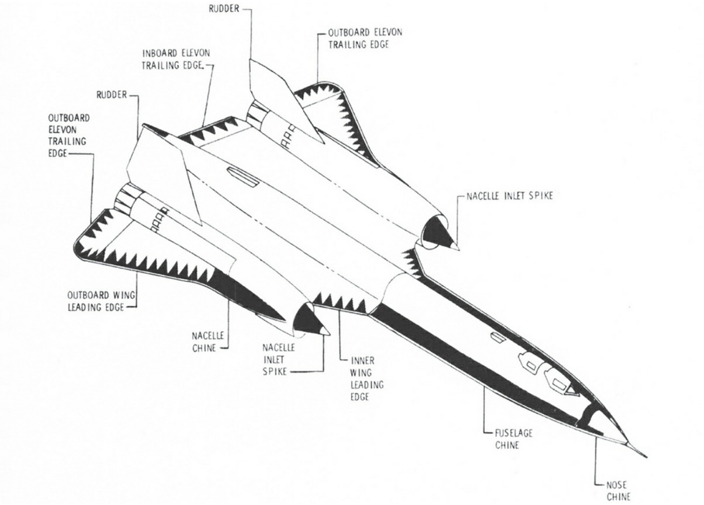
The Air Force was obliged to comply with the rules of the 1907 Hague Convention, however, which stipulate that military aircraft must bear conspicuously placed national insignia (which would necessitate using non-heat resistant paint). Adding a touch of humour to an otherwise serious matter of international diplomacy, Ben Rich, who was chief thermodynamicist at the time, asked, 'Who'll be up there to look at them?' Notwithstanding, an expensive red, white and blue paint was developed that would not tarnish after repeated 'heat-soaks'.

Another, perhaps more important problem for Ben Rich and his engineers concerned the air conditioning system. The challenge was to produce a system capable of cooling down air at up to 430°C to a temperature more useful for the job. A two-stage system was devised whereby air bled from the 9th stage of the J58's compressor was led through a ram air bleed, air cooled and then fed through a fuel cooler. The result was conditioned air at -20°C, which was supplied to the cockpit and maintained regulated steady-state temperatures of between 20 and 30°C; it was then ducted to various equipment bays and the nose wheel bay and, having reached a temperature of between 60 and 75°C, it was vented overboard through exit louvres. The nose gear tyres were also cooled in this manner. A pressure differential of 1psi was maintained in the bays to ensure that flow always vented out. As fuel was burnt off and the temperature of that remaining increased, a system of smart valves was used to direct hot fuel to the engines and cool fuel back into the tanks for environmental cooling. Thermodynamic heating dictated that fuel in the wings was used first, due to their high surface area to volume ratio. Fuel tank sequencing was automatic and centre of gravity control was provided by pumping fuel from one area to another.

In an interview, Ben noted that an interesting side effect of fuel depletion was that differential expansion between the top of the fuselage and the cooler underside, where fuel remained, pushed the chines downwards, marginally changing their aerodynamic characteristics.

RADAR ABSORBENT MATERIALS (RAM)

In addition to their extreme speed and altitude performance, the Blackbirds also boasted a significantly reduced RCS. This was made possible through its shape – designing few corner reflectors – and the use of radar absorbent materials (RAM).


RUDDER
OUTBOARD ELEVON TRAILING EDGE
INBOARD ELEVON TRAILING EDGE
RUDDER
OUTBOARD ELEVON TRAILING EDGE
NACELLE INLET SPIKE
OUTBOARD WING LEADING EDGE
NACELLE CHINE
NACELLE INLET SPIKE
INNER WING LEADING EDGE
FUSELAGE CHINE
NOSE CHINE

Radar Absorbent Materials (RAM) framed the outline of the SR-71 to reduce its Radar Cross Section (RCS). These materials together with the blended shape and tiny iron balls within its black paint all combine to mark this the first truly operational stealth aircraft. (USAF)

An SR-71 scale model built to undertake radar calibration test in Lockheed's first anechoic chamber. (Lockheed Martin via Tony Landis)

Basically, two types of composite materials were used and they accounted for approximately 4 per cent of the aircraft's structural weight. Phenyl silane material was used in the plastic rudders, wing leading edge vee, the elevon trailing edge vee and the tail cone.

Silicone-asbestos and F174 glass laminate assemblies were used to form the contours of the fuselage chine and nacelle inlet chine, and the inserts in the wing leading edges and elevon trailing edges. The nacelle inlet spike cone, aft section and some of the interior structure were made from silicone-asbestos only. All silicone-asbestos and F174 glass laminate panels were considered to be primary structure.

Silicone-asbestos assemblies generally consisted of inner and outer skins and edge members laminated from silicone resin and impregnated asbestos mat, with honeycomb cores constructed from a similar material. F174 glass laminate assemblies generally consisted of inner and outer skins and edge members laminated from epoxy prepreg glass fabric with an HRH 327 honeycomb core. Assembly of these components was obtained by secondary bonding.

POWERPLANT

The SR-71 was powered by two Pratt & Whitney JT11D-20s (J58 in US military nomenclature). The engine was 18ft long, with a diameter of 55.43in. Weighing in at 6,250lb, it generated 23,900lb at maximum military thrust and 34,000lb in full afterburner (A/B), and had a total pressure ratio of 2.93:1.

The engine had its origins in a US Navy interceptor project that was subsequently cancelled. Despite this, it retained its earlier even-numbered Navy designation – hence an even-numbered engine (J58), installed in an Air Force airframe. The engine was designed for continuous operation at compressor inlet temperatures above 400°C. Its stretched design criteria – particularly the high Mach number and associated large air-flow turn-down ratio – led to the development of a unique variable cycle engine (later known as a bleed bypass engine), a concept conceived (and patented) by Pratt & Whitney's Robert Abernethy.

To solve the problems associated with high compressor inlet temperatures (CIT) the single rotor, nine-stage, 8.5:1 pressure ratio compressor, used a bleed bypass system at high Mach. When opened, 24 bypass doors bled air from the fourth stage of the compressor and routed it down six ducts, past the rear stages of the compressor, the combustion section, and the two-stage turbine, before the bled air was then reintroduced into the turbine exhaust, around the front of the afterburner. Here it was used to both oxygenate fuel introduced in the afterburner and provide a cooling air film for the afterburner liners and exhaust nozzle flaps. Transition to bypass operation was scheduled by the main fuel control as a function of compressor inlet temperature and engine speed; this usually occurred within a CIT range of between 85 and 115°C and corresponded to a Mach range of between 1.8 and 2.0 Mach.

In addition to reducing the effects of high temperatures, the bleed bypass process also sharply reduced airflow pressures across the rear stages of the compressor assembly, preventing them from choking with high-velocity airflow; it also prevented the front stages from stalling due to low-mass airflow. To further minimize the possibility of stalling the front stages of the rotor blades at low engine speeds, the engine incorporated movable inlet guide vanes (IGVs) to help guide airflow to the compressor. During take-off and acceleration to intermediate supersonic speeds, these remained in the 'axial' position, in order to optimize air ingestion into the compressor. A change to the 'cambered' position occurred at the same CIT values as those set to activate operation of the bleed bypass process to ensure that the CIT remained within limits; the compressor temperature had a maximum limitation of 427°C. Failure of the IGVs to transition to the 'cambered' position was a mandatory abort item on the 'Go, No-Go' checklist.

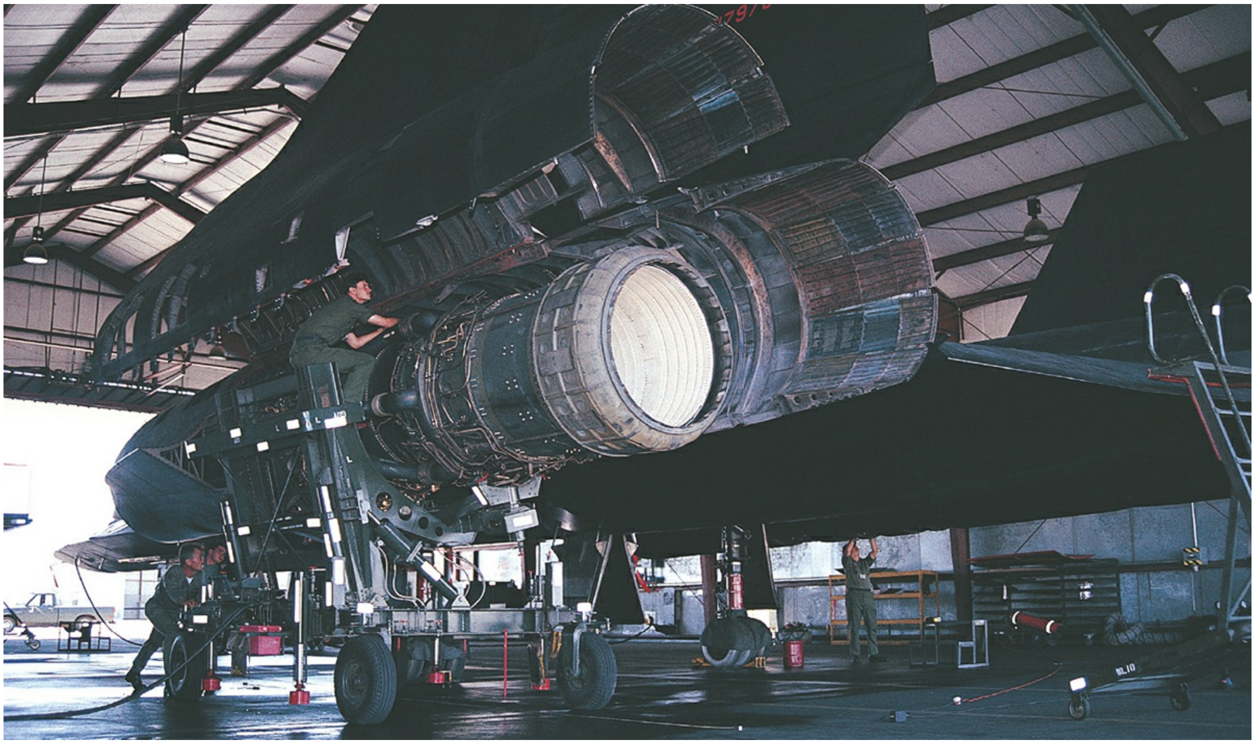
Turbine discharge temperatures were monitored by exhaust gas temperature (EGT) thermocouples. At all engine-operating conditions of Military or above, EGT remained at approximately 815°C. However, cooling air for the turbine routed through the core of the engine rose and fell with compressor inlet temperatures. Compressor and turbine disk life was governed by thermal cycles to Mach 3 and above for front end disks, and by time above Mach 3 for aft end disks. The most sensitive of the latter was the 1st Stage Turbine Disk. This presented Pratt & Whitney with one of its greatest challenges that was eventually overcome by Joseph Moore. A materials engineer at the Florida Research and Development Center, Moore perfected Astralloy, a special high-temperature alloy used in the first and second stages disks of the J58's turbine.

The main and reduction gearboxes were mounted beneath the diffuser section of each engine and were mechanically linked to its compressor section by a drive shaft driven off a bevel gear in the #2 Bearing Compartment. The main gearbox was connected to an external drive shaft for starting the engine, while the reduction gearbox provided mechanical power to the airframe-mounted accessory drive system (ADS), which included a constant-speed drive linked to a 60KVA electrical generator, two hydraulic pumps and a fuel circulating pump.

The J58 also pioneered the introduction of other engine innovations. It saw the first application of variable geometry, afterburner spray-bars, and was the first engine to be rated for continuous use in afterburner. It was also first to incorporate the use of directionally solidified turbine vanes, in addition to being the first dual cycle engine – a turbojet/ramjet.

Pratt & Whitney Government Engine Business Programme Manager, Arnie Gunderson, described some of the less-known attributes of the J58:

> Development of the J58 engine may have been sufficient to allow an aircraft to reach Mach 3, but in order to sustain that speed, a systematic approach to airflow management was necessary. Kelly Johnson delegated that engineering challenge to Ben Rich, who worked very closely with Bill (Catfish) Brown at Pratt & Whitney, to develop and perfect the propulsion system. As noted later, the inlet control system was designed to regulate the movements of the inlet spike, and the forward and aft bypass doors. During the acceleration portion of the ascent to cruise, the inlet spike started to move aft at about Mach 1.6. Its primary function was to position the primary shock wave in the throat, or narrowest portion of the inlet. As air crosses that shock wave, it is slowed down relative to the nacelle. In slowing down, the air pressure increases, as does the air temperature. The forward and aft bypass doors' primary function is to regulate the air pressure inside the nacelle to about 15 psi. Excess air is dumped overboard by the forward doors until about Mach 3.15, when all air entering the nacelle is needed for thrust. The aft bypass doors route much of the excess air around the outside of the engine until the air is reintroduced to the exhaust gas stream at the engine nozzle. The combined airflow passes through the ejector, which is in fact a convergent/divergent nozzle that expands the exhaust gas to an approximate 45:1 ratio, resulting in Mach 3.3+ exhaust gas velocities. Almost all supersonic capable aircraft dump excess air overboard, resulting in huge amounts of drag. Only the A-12, YF-12, SR-71 and XB-70 aircraft achieved efficient Mach 3 + cruise by utilizing all the air that entered their respective inlets. The Blackbirds actually recover 88 per cent of the energy used at cruise to compress inlet airflow.

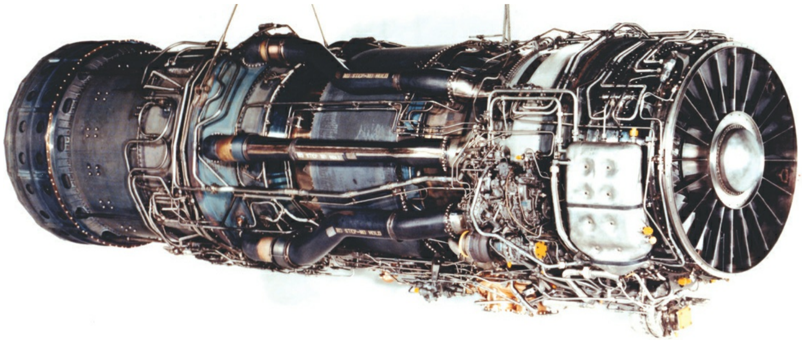


Access to the J58 was via an ingenious hinge arrangement along the top of the engine nacelle. (Paul F. Crickmore)

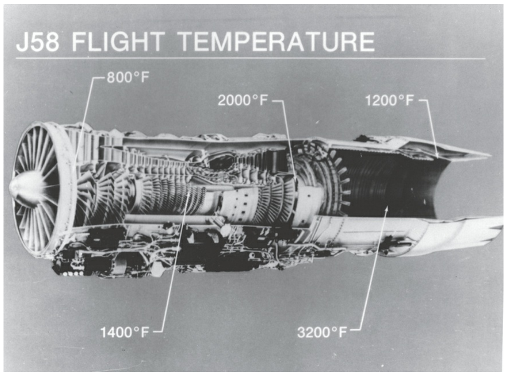
> A significant consideration had to be made for thermal expansion of the engine. The J58 is a very 'loose' and inefficient engine at subsonic and low supersonic speeds. As it accelerates, inlet temperatures increase and metals expand at a known rate. The engine grows approximately 6in. in length and 2 ½in. in diameter at cruise. At that condition, all the seal tip clearances are driven to their minimums, and internal leakages disappear. The main engine mount is fixed inside the nacelle at the main diffuser case of the engine, about 4ft aft of the inlet case. Some thermal growth is tolerated at a spring seal, on the inlet case of the engine, but most of it is accommodated by the three swinging uniball mounts at the Turbine Exhaust Case. The circumferential growth is accommodated in the design of the accessory driveshaft. It is mounted with a 2 ½in. vertical offset between the engine reduction gearbox and the aircraft accessory drive gearbox. As the engine expands circumferentially, that offset decreases to zero when at cruise, ensuring smooth vibration-free power to the aircraft hydro pumps and generators.

People often wonder just how fast the aircraft could go. It is important to remember the aircraft was designed to fly at a very specific speed and altitude, that is Mach 3.23 and 80,000ft on a Standard Day. Every aspect of the airplane is designed to be perfect at those conditions. There are variations in the atmosphere from Standard Day, and higher speeds and altitudes were often experienced. However, the limits for speed are governed by the Compressor Inlet

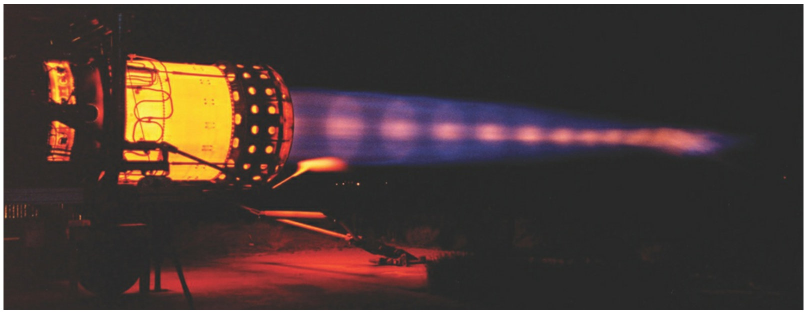
Temperature of 427°C. A war-time emergency limit was established during the Libyan conflict of 450°C, but this required extensive inspection of the 1st stage compressor afterwards. It is known from flight test experience that at about Mach 3.4, the instability of the air in the inlet reaches the engine and causes it to flame out. The coldest air in the atmosphere occurs at about 65,000ft. It increases as altitude increases after that. 80,000ft is a limit based on that Standard Day data and the change in temperature experienced at Mach 3.2.



The Pratt & Whitney J58 engine generated 23,900lbs at maximum military thrust and 34,000lbs in full afterburner (A/B). Note three of the six bypass ducts used in the unique bleed bypass system at high Mach. (Lockheed Martin)



The enormously high temperatures encountered by the J58 in Mach 3.2 flight dictated the need to develop a number of new materials able to withstand prolonged operation in a 'thermal thicket'. (Lockheed Martin)



Note the shock diamonds in the exhaust plume of this J58 undergoing tests on a static rig. Shock diamonds form in a supersonic exhaust plume if the exit nozzle is slightly over-expanded, causing the gases' static pressure to be less than the ambient air pressure. The resulting pressure rise substantially increases the gases' static temperature, causing reignition of unburnt fuel vapour in the exhaust plume. (Lockheed Martin)

FUEL

The major components of the engine fuel system comprised the engine-driven fuel pump, main fuel control, windmill bypass valve and variable geometry fuel nozzles in the main burner section. The two-stage engine-driven main fuel pump consisted of a single centrifugal pump that acted as a boost stage, and its second stage, made up of two parallel gear-type pumps with discharge check valves; this configuration enabled continued operation if either pump failed.

The main fuel control metered main burner fuel flow and controlled the bleed bypass, start bleed valves, IGVs and exhaust nozzle modulation. It regulated engine thrust as a function of throttle position, compressor inlet air temperature, main burner pressure and engine speed.

Afterburner operation was always at military-rated engine speed and EGT, and the control had a remote trimmer for EGT regulation. The pilot set one engine at a time, during EGT trim checks prior to take-off, to ensure that the temperature remained within limits. The engine was equipped with an eight-unit can-annular combustion section with 48 variable-area, dual-orifice fuel nozzles, arranged in clusters of six nozzles per burner.

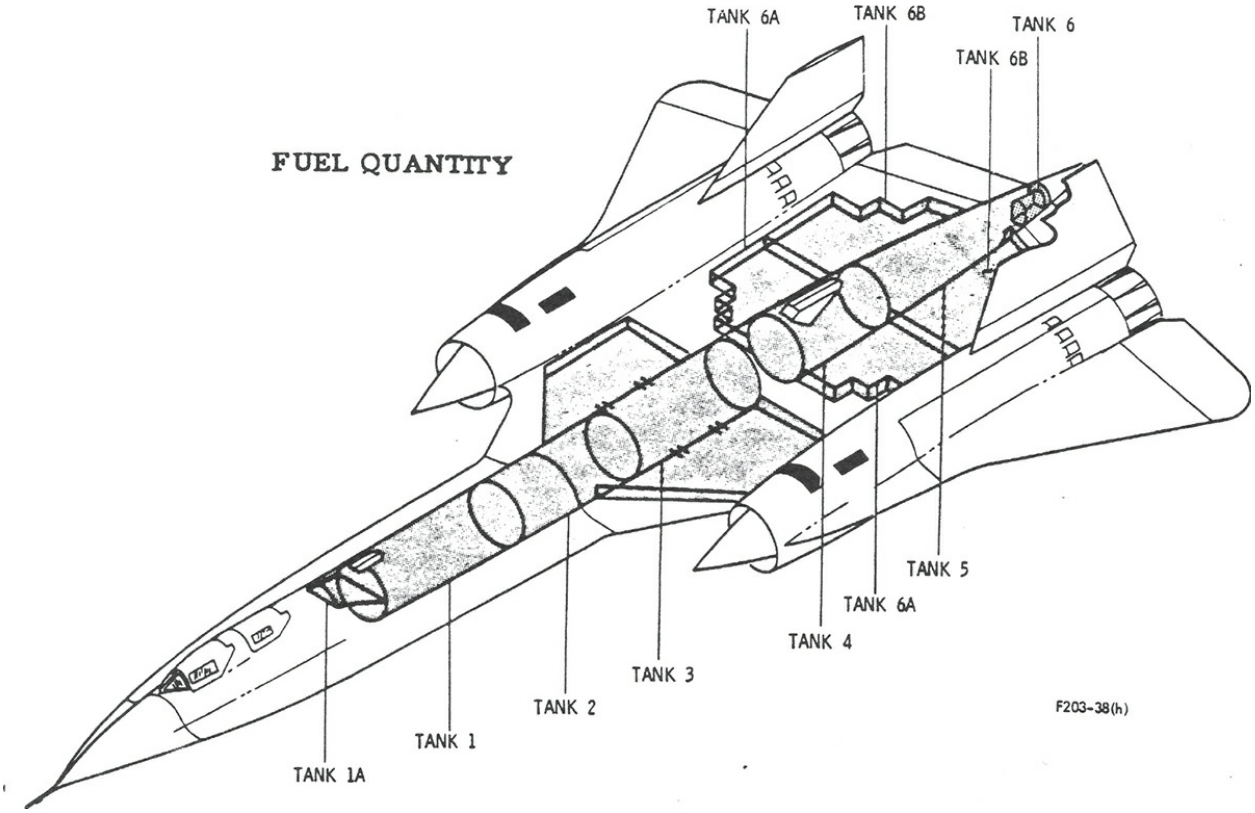
The extremely high airframe temperatures encountered by the SR-71 during high-Mach cruise ruled out the use of JP-4 fuel, since it would have ignited in the aircraft's 'wet' tanks. Instead, bespoke JP-7 (known as PWA 535 or PWA

523E in the *Flight Manual*) was used, also containing a lubricant to aid fuel pump operation. It was developed by Pratt & Whitney in partnership with Ashland, Shell and Monsanto and remained stable despite the high-temperature environment.

The fuel was first used as a hydraulic fluid to activate the main and afterburner fuel nozzles before being injected into the fuel burners at more than 350°C and 130psi. Such high fuel burn temperatures presented the design team with another problem – standard electrical plugs were incapable of igniting it. This was overcome by developing a unique chemical ignition system (CIS) using triethyl borane, which is extremely flash-sensitive when oxidized.

A small TEB tank was carried and the fluid used to start or restart the engines and afterburners on the ground or in the air. To ensure that the system remained inert when not in operation, gaseous nitrogen was used to pressurize the TEB tank and power the piston that injected it into the burner cans during the ignition process, regardless of engine operating conditions.

As fuel was burnt, gaseous nitrogen was also used to pressurize the fuel tanks to prevent them from being crushed as the aircraft descended to lower levels to either air refuel or land. Liquid nitrogen was carried aloft in three dewars in the nose gear well. Each time the SR-71 air refuelled, the nitrogen gas in the fuel cells was vented overboard and range was therefore governed by the number of times the aircraft could be refuelled before its liquid nitrogen supply became depleted.

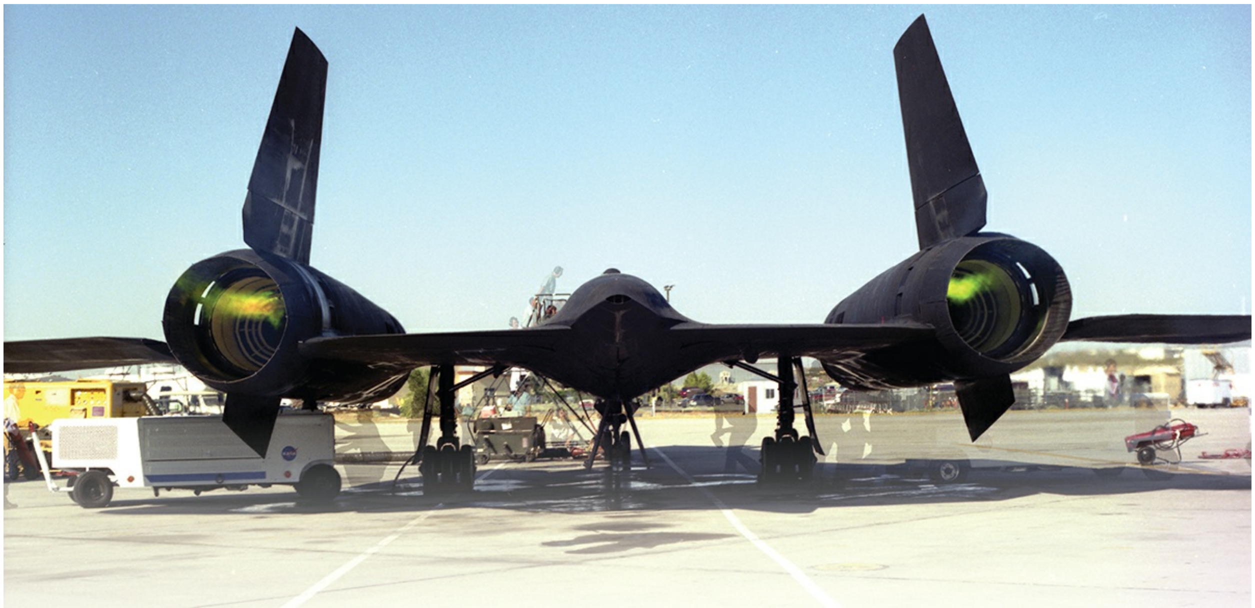

FUEL QUANTITY
TANK 6A
TANK 6B
TANK 6
TANK 6B
TANK 5
TANK 6A
TANK 4
TANK 3
TANK 2
TANK 1
TANK 1A
F203-38(h)

Fuel was carried in 'wet tanks' located in the fuselage and inboard wing sections. In addition to its primary use, it was also pumped to and from various tanks to control the aircraft's centre of gravity (COG), throughout the SR-71's vast flight envelope. (USAF)

Leaking JP7 fuel typified SR-71 operations. (USAF)

Development of a durable fuel tank sealant was an ongoing problem. Cruising at high Mach, it has been estimated that the aircraft expanded 3in. in length due to thermodynamic heating. Upon descending to air refuel, the airframe cooled, a process that was considerably speeded up as fuel at -50°C was pumped into the tanks from a KC-135 or KC-10 tanker at 5,000lb per minute. This cycle of events was repeated up to six times during an extended mission and many more times in the period between major overhauls. The pounding taken by the silicon-based sealant invariably led to it cracking, causing fuel to leak from numerous gaps.

This phenomenon was especially apparent when the aircraft was wholly fuelled, as most of the leaks appeared on the topside of the tanks, which became hotter and drier during high-Mach flight. As a consequence, it was necessary to perform routine resealing and extensive depot-level fuel tank maintenance when an SR-71 was returned to Palmdale (the old sealant was usually stripped away and replaced). It was a problem that remained with the aircraft throughout its operational life.



An emerald green flash indicates that a shot of triethyl borane (TEB), from the aircraft's unique chemical ignition system (CIS), has ignited JP7 fuel in the engine's combustion chamber – it's also used for the same purpose in the afterburner. (Lockheed Martin via Tony Landis)

The leaks, Mike Relja recalls, were monitored closely.

> The SR-71, 2-5 fuel system had fuel tank leakage limits, and inter-tank leakage limits. Provisions were also provided for fuel tank leak evaluations, and a fuel tank leak chart was documented and carried in each aircraft. Each aircraft also carried a delayed discrepancy stating 'Fuel tanks leaks as per chart'. The crew chief would fill the aircraft full, 80,000lb, service the LN2 system to pressurize the tanks, let it stabilize for an hour or so, then call the fuel shop specialist to measure and document the fuel leaks.
>
> Even though the fuel was very hard to ignite – it had a minimum flash point of 60°C – anything soaked with the fuel can burn if given enough heat. You don't want to be servicing LOX [liquid oxygen], and TEB while refuelling – those were always done first, then put the fuel onboard later, the closer to take-off the better. You also wanted to keep the fuel off the tyres and composite chine panels to prevent delaminating. I remember the first time I witnessed an SR-71 with the engines running. It was sucking fuel off the floor in little tornadoes, and all the while the headers of the start carts were dumping flame on the floor. I thought these people were out of their rabbit ass minds. But after working on and with this outstanding aircraft and fuel for over 25 years, never experiencing a fire problem, I got used to it. I respected it for what it was designed to do.

OIL SUPPLY SYSTEM

The engine and speed-reduction gearbox were lubricated by an engine-contained ‘hot tank’ closed system. Its oil was cooled by circulation through an engine fuel-oil cooler, the tank being mounted on the lower side of the engine compressor case tank; its capacity was 6.7 US gal. The oil was gravity-fed to the main oil pump and forced through a filter and the fuel-oil cooler; from there it was distributed to the engine’s bearings and gears before being returned to the tank by scavenge pumps. Engine oil temperature was controlled by engine fuel that was passed through the main fuel-oil heat exchanger. The normal temperature of the oil ranged from 20 to 290°C; at 15°C it was the consistency of honey, at 0°C it was solid. Therefore, before engine start it needed to be pre-heated to 20°C, a task that took several hours – especially when operating from the UK during winter months.

ACCESSORY DRIVE SYSTEM

An ADS was mounted forward of the engine in each nacelle. It consisted of a constant speed drive, an accessory gearbox and an all-altitude oil reservoir. Power from the engine was transmitted to the ADS via a reduction gearbox on the engine and a flexible drive shaft. The constant speed drive within the ADS converted the variable shaft speed to a constant rotational speed to power the AC generator. Two hydraulic pumps and a fuel-circulating pump were also mounted on the ADS gearbox. The two hydraulic pumps supplied power to the A and L or B and R hydraulic systems, while the fuel circulating pump supplied fuel to the aircraft heat sink system.

AIR INLET CONTROL SYSTEM

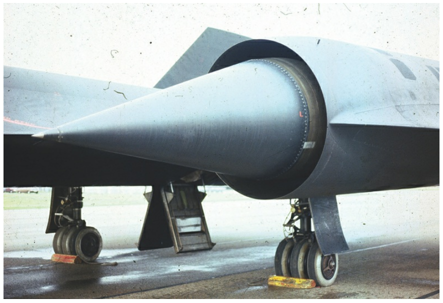
The Blackbird family boasted a unique, highly efficient air inlet/powerplant system that generated thrust via three components: an asymmetric mixed-compression, variable-geometry inlet; the J58 engine; and a convergent/divergent blow-in door ejector nozzle. The air inlet control system (AICS) regulated the massively varying internal airflow throughout the aircraft’s entire flight envelope, ensuring that the engines received air at the correct velocity and pressure.

To satisfy the J58's voluminous appetite for air at ground idle, taxiing and take-off, the centrebody spikes were positioned fully forward, allowing an uninterrupted flow to the engine compressor. Supplementary flow was provided through six forward bypass doors, and a reverse flow was set up through exit louvres on the spike's centrebody and a set of variable-area 'inlet ports' that were regulated by an external slotted band, which drew air in from two sets of doors. The task of operating these doors was initially manually controlled by the pilot, but later accomplished automatically by a digital automatic flight inlet control system (DAFICS) computer. The DAFICS also controlled the position of the electrically operated, hydraulically actuated spike.

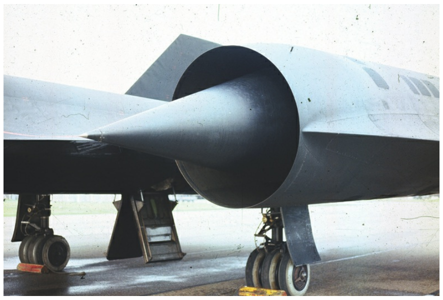
Operating together, the forward bypass doors and centrebody spike controlled the position of the normal shockwave, just aft of the inlet throat. To optimize inlet efficiencies, the shock wave was captured and held inside the converging/diverging nozzle just behind the narrowest part of the 'throat', thereby achieving the maximum possible pressure rise across the normal shock.

Once airborne, the forward bypass doors closed automatically as the undercarriage retracted. At Mach 1.4 the doors began to modulate, again automatically, to obtain a pre-programmed ratio between dynamic pressure at the inlet cowl on one side of the throat and static duct pressure on the other side. Upon reaching 30,000ft, the inlet spike unlocked and at Mach 1.6 began a rearward translation, achieving its fully aft position of 26in. at Mach 3.2, the inlet's most efficient speed. As the spike moved aft, the 'capture airstream tube area' increased by 112 per cent, while the throat restriction decreased by 46 per cent of its former size.

A peripheral 'shock trap' bleed slot (positioned around the outer circumference of the duct, just forward of the throat and set at twice the boundary layer displacement thickness) shaved off 7 per cent of the stagnant inlet airflow and stabilized the terminal (normal) shock. It was then rammed across the bypass plenum through 32 shock trap tubes spaced at regular intervals around the circumference of the shock trap. As this compressed, tertiary air travelled down the secondary bypass passage; it firmly closed the suck-in doors and cooled the exterior of the engine casing before being exhausted through the ejector nozzle. Potentially turbulent boundary layer air was removed from the surface of the centrebody spike at the point of its maximum diameter and then ducted through the spike's hollow support struts before being dumped overboard through nacelle exit louvres. The aft bypass doors were opened at mid-Mach to minimize the aerodynamic drag that resulted from dumping air overboard through the forward bypass doors.



The inlet spike regulated the volume of air entering the inlet by moving backwards from the position seen here as the aircraft's speed increased. (Paul F. Crickmore)



Here the inlet spike is in the fully aft position. (Paul F. Crickmore)

By carefully dovetailing the above systems, the inlet was made capable of generating internal duct pressures of 18psi. Considered against the ambient air pressure at 82,000ft of just 0.4psi it is immediately apparent that this extremely large pressure gradient produced a similarly large forward thrust vector. In fact, at Mach cruise, it accounted for no less than 54 per cent of the total thrust produced; a further 29 per cent was produced by the ejector, while the remaining 17 per cent was generated by the J58 engine.

THE UNSTART

Innovative ways of problem solving often brought with them their own unique issues, and the variable geometry inlet was probably at the top of that list. BC

Thomas, high-time operational and SR-71 flight test pilot, with more hours on type than any other HABU pilot, has kindly provided a clear and eloquent description of this unique phenomenon that was for many years the scourge of Blackbird flight crews.

> Turbojet aircraft capable of supersonic flight must solve the problem of slowing the incoming air to the engine's compressor face because the engine cannot tolerate supersonic airflow into the compressor. Sophisticated supersonic airplanes, like the F-15 and Concorde, move ramps and bypass air associated with the engine inlet to slow the airflow and improve efficiency. The SR-71 is different: its inlet, called a 'Mixed Compression Inlet,' uses the spike's contours and the geometry of the inlet wall to form a series of oblique shock waves within the inlet, which slows the supersonic air and retains as much air pressure as possible for the engine's compressor. As speed increases, the spike retracts a maximum of 26in. to provide optimum compressor inlet pressure for all speeds from Mach 1.6 to Mach 3.2. Maintaining the shock inside the inlet decreases drag and improves pressure recovery and this, in turn, provides more power and greater fuel efficiency. All supersonic airflow must terminate in a normal (perpendicular) shock wave before becoming subsonic. This normal shock is optimally positioned just aft of the narrowest point in the inlet, called the 'throat.' An 'unstart' is the sudden and violent expulsion of the normal shock from the inlet throat to outside the inlet, causing the compressor inlet pressure to decrease instantly from ~13-14psi to ~3.0psi. Unstarts could be caused by an inlet control problem, turbulence, rapid changes in angle-of-attack, side-slip (uncoordinated flight), a compressor stall, aft bypass door opened at supersonic cruise, a 'tight inlet' where the forward bypass door is more closed than optimum, the spike moving more than 1/2in. aft, or some combination thereof. Most times, we would have no warning, but sometimes we could feel a rumble in the airframe which might herald the onset of an unstart. An unstart causes instant loss of most of the thrust from that engine. It sounds like a very loud compressor stall, the aircraft yaws toward the unstarted engine, and the exhaust gas temperature (EGT) is likely to rise due to the sudden decrease in airflow to the engine. The aircraft always has a tendency to pitch (rise) nose-up during an unstart.

The Blackbirds flew nose-high at a 6-degree angle of attack when in cruise. Therefore, to achieve optimum airflow in flight, the pitot tube together with the inlet spikes pointed down 5.5 degrees when on the ground. Similarly, airflow generated by the forward fuselage chine required the inlet spikes to toe-in 3 degrees for the same reason. (Kevin Gothard)

> The SR-71 is flown referencing 'Knots Equivalent Airspeed (KEAS)' that is the airspeed at sea level which yields the same dynamic pressure as the dynamic pressure at which the aircraft is flying. For example, an SR-71 indicating Mach 3.2 and 350 KEAS at 80,000ft would experience the same 'wind blast' (dynamic pressure) as if it were flying at 350kt at sea level, although its speed through the air (True Airspeed) at 80,000ft would be ~1,850kt.
>
> The most violent unstart occurs at maximum dynamic pressure, measured in KEAS, and would occur at Mach 2.6 and 450 KEAS in the acceleration/climb, at which a KEAS-bleed schedule starts (10 KEAS decrease for every 0.1 Mach number increase), so that at subsequent higher speeds and altitudes, the KEAS would be less. Mach 2.6 occurs at ~60,00ft for a normal 450 KEAS climb schedule. The most dangerous unstart occurs at highest speed (Mach 3.3) and above 80,000ft because the inlet pressure loss is more critical due to the extremely low outside air pressure (~0.4 psi), low aerodynamic damping, and low KEAS for controllability. The EGT is more likely to rise to dangerous, catastrophic temperatures, and it may be more difficult subsequently to recapture the normal shock into the inlet throat. At high Mach (above Mach 3.1), aircraft pitch-up might require full-forward control stick travel and possibly simultaneous nose-down trim to arrest the pitch-up and restore normal angle-of-attack and pitch attitude. The initial upset can be dramatic because at Mach 3, one degree of pitch deviation will result in 3,000ft-per-minute rate-of-climb (or descent). During an initial flight test of the SR-71, an unstart occurred on the right inlet at Mach 3.2, in a 35° banked right turn, with the centre-of-gravity (cg) at 26 per cent mean aerodynamic chord (MAC). The aircraft pitched up and the pilot was not able to arrest the upward movement. The SR-71 broke up in-flight, and the test pilot, Bill Weaver, bailed out successfully, but the Lockheed Flight Test Reconnaissance and Navigation Systems Specialist, Jim Zwayer, was killed. Afterward, the cg limit was published at 25 per cent MAC with a severe warning in the Flight Manual never to exceed 25 per cent MAC! After 1983, the Digital Automatic Flight and Inlet Control System (DAFICS) was installed in the SR-71. This innovation allowed a more precise control of the inlet parameters and also made possible more maintenance information about all flight/inlet control systems. A built-in test was incorporated which dynamically tested the inlet system on the ground. In addition, Lt Col Tom Tilden, an experimental test pilot assigned to the SR-71 test force at Edwards AFB (flying from Air Force Plant 42, Palmdale), devised several in-flight tests which demonstrated that the original schedule for the inlets was not precisely accurate for gross weight, altitude, outside air temperature, and speed. Changes in DAFICS fixed these problems. Lt Col Tilden also devised a way to automatically 'loosen the inlet' so that no subsequent unstart, due to an inlet off-schedule, would likely occur. All of the inlet activity would be recorded by DAFICS and reported to maintenance for subsequent analysis and repair. After these improvements in inlet scheduling and reporting, unstarts, which occurred quite frequently before DAFICS (approximately every 4–5 flights) became much more infrequent. The SR-71 crew force was delighted!

Recovery from an unstart involved an automatic computer-sequenced inlet restart. This involved the spike being driven forwards and the forward bypass doors opening to recapture and reposition the shock wave. The spike then returned to its correct position, followed by the bypass doors, which reconfigured the inlet to its optimum performance.

To improve the duct's diffusion rate, small, rounded protuberances, referred to by the design team as 'mice', were positioned at the rear of the duct. Acting like vortex generators, they changed the area of distribution and thereby improved recovery. Early in the programme, Lockheed engineers also rechristened other assemblies – the free-floating trailing edge flaps at the end of the nacelles, used to help shape the exhaust plume, were referred to as 'tail-feathers'. Perhaps a little less obvious were the terms 'onion slicer', used to describe the forward bypass system, and 'cabbage slicer', for the aft bypass system. A memo later issued from upon high instructed that henceforth correct terminology would be used at all times.

FUEL SYSTEM

The SR-71 had five individual fuselage tanks, numbered 1A, 1, 2, 4, and 5, and two wing-fuselage tank groups numbered 3 and 6 (tank 6 was further divided into 6A and 6B). Interconnecting plumbing and electrically driven boost pumps were used for fuel feed, transfer and dumping. The fuel system moved the aircraft's centre of gravity by automatic tank sequencing to the engine feed manifolds or manual aft transfer into tank 5 when it was less than full, or manual forward transfer into tank 1.

Tank capacities were:

Tank	Fuel capacity (US gal)	Fuel weight (lb)
1A	251.1	1,650
1	2,095.9	13,770
2	1,974.1	12,970
3	2,459.7	16,160
4	1,453.6	9,550
5	1,758.0	11,550
6A (forward)	1,158.3	7,610
6B (aft)	1,068.5	7,020
Total	12,219.2	80,280

Sixteen single-stage, centrifugal, AC-powered boost pumps supplied fuel to the manifolds. Tanks 1 and 4, which normally fed fuel to both engines, were each equipped with four pumps, while tanks 2, 3, 5 and 6 each had two pumps. Where the pumps were grouped in pairs, either pump was capable of supplying fuel at sufficient pressure to permit engine operation at reduced afterburning thrust if the other failed.

ELECTRICAL SYSTEM

Electrical power was normally supplied by two AC generators, each rated at 60KVA. They were mechanically driven by their respective engines through constant speed drive (CSD) units and operated in parallel. They provided 115/200V, 400-cycle, three-phase power to five AC buses and two 200A transformer-rectifiers, which energized three 28V DC buses. Either generator was capable of supplying the normal AC and DC power requirements of the aircraft.

Two 25A/hr batteries provided limited emergency power if both generators were off or inoperative, or if both transformer-rectifiers failed; each battery individually supplied one of the two essential DC buses. The maximum duration of the dual-battery power system was about 40 minutes, provided that all unnecessary electrical equipment was turned off.

Heat was also responsible for electrical systems problems, especially in the high-output generators. Heat-related generator failures caused many air aborts during the first two years of SR-71 training and Category III testing. After the loss of SR-71B ’957 to a double generator failure on 11 January 1968, a single generator failure was flagged as a mandatory abort item that meant ‘land as soon as possible’. Over the next year, SR-71s with generator failures landed at bases across the US. Various modifications were tried before the problem was finally isolated and solved by using solder with a much higher melting point.

HYDRAULIC SYSTEMS

The SR-71 had four separate hydraulic systems, each provided with its own pressurization reservoir and engine-driven pump. Pumps for the A and L system were driven from the left engine ADS; the B and R pumps were powered by the right engine ADS. The A and B hydraulic systems powered the flight controls.

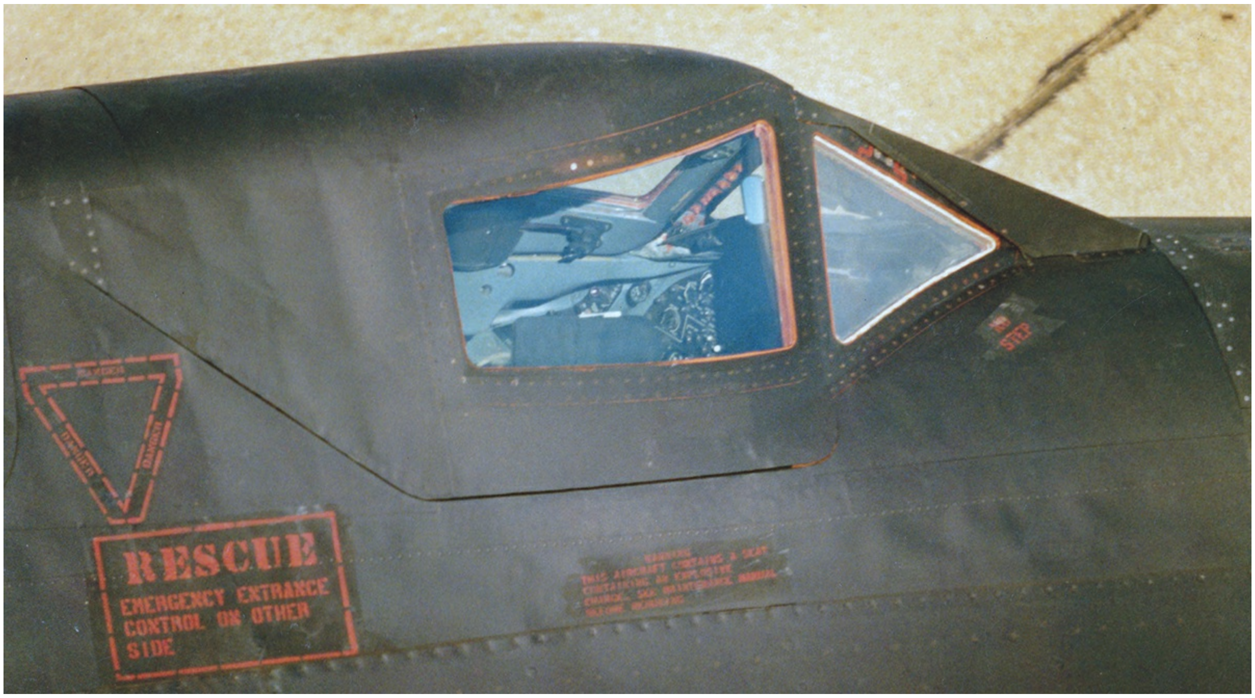
The L hydraulic system powered the left engine air inlet system, the landing gear, brakes, air refuelling door and receptacle, and the nose-wheel steering. The R system powered the right engine air inlet system; if pressure in the L system dropped to less than 2,200psi, the R system automatically powered the landing gear retraction cycle.

STABILITY AUGMENTATION SYSTEM

The SR-71's CG was automatically moved aft during acceleration to high-Mach flight to reduce trim drag and improve elevon authority in both the pitch and roll axis. The fuselage chine produced lift forward of the aircraft's CG, which had the effect of destabilizing it in the pitch axis and reduced aft CG travel, resulting in low static margins of stability and safety. Additionally, the chine had an adverse aerodynamic effect on the aircraft when performing sideslip manoeuvres at cruise angles of attack (AoA) (approximately 6° of positive Alpha (AoA)). This, coupled with the low aerodynamic damping inherent to flight at high altitudes, left the SR-71 only marginally stable in pitch and yaw at high Mach.

Control in this delicate, critical corner of the flight envelope was achieved by the aircraft's elevons and all-moving fins, working through an automatic flight control system (AFCS) controlled by the DAFICS computers. The AFCS consisted of three subsystems, a stability augmentation system (SAS), autopilot and Mach trim system. As coordinating system, the AFCS provided pitch, roll and yaw stabilization via the control surfaces. Eight rate-sensing gyros detected divergence from stable flight and, together with three lateral accelerometers, also provided motion-sensing signals that were applied to the multi-redundant SAS circuits in the DAFICS. Control over the AFCS was provided to the pilot via 'Pitch SAS', 'Roll SAS' and 'Yaw SAS' switches located on the right console panel. In addition to responding to the signals from DAFICS, the servos could also be activated by direct stick and rudder pedal inputs.

The Mach trim system provided speed stability up to Mach 1.5 or below that speed, depending on whether the aircraft was accelerating or decelerating – a period during which the autopilot could not be engaged. It compensated via the pitch trim actuator for the aircraft's propensity to 'tuck' nose down while accelerating through the Mach, and rise nose up while decelerating.



The heavy cockpit canopy was reminiscent of those used on the F-102 and F-106. (Paul F. Crickmore)

ASTRO-INERTIAL NAVIGATION SYSTEM

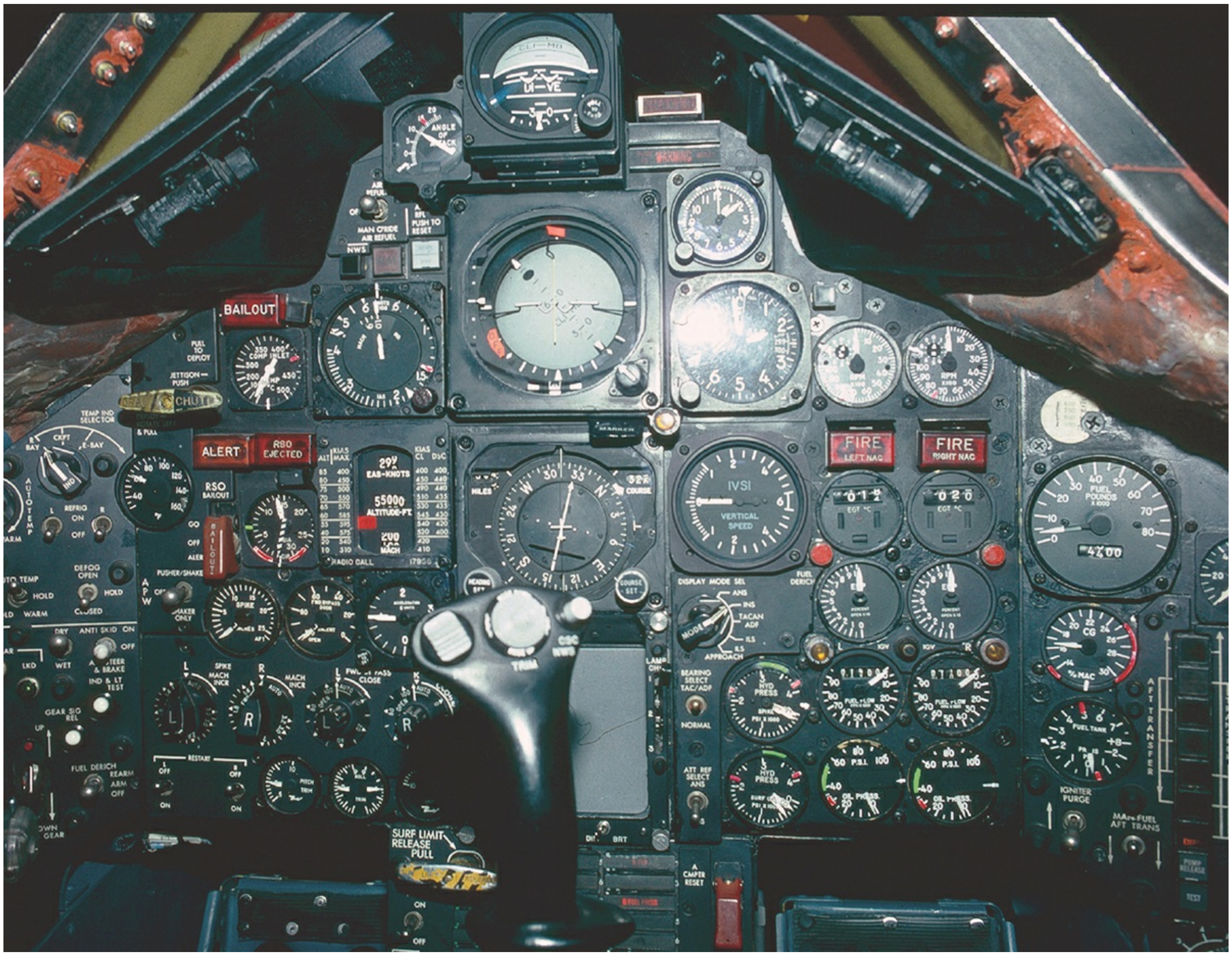
The SR-71's reconnaissance-gathering missions took it to some of the most politically sensitive areas of the world. It was therefore essential that it should be equipped with the most accurate navigation system available, particularly bearing in mind that it would be flying at a velocity of 3,000ft per second. The Nortronics Division Astro-inertial Navigation System, used in the Skybolt air-to-surface missile, was modified for use in the SR-71 and designated as the NAS-14V2.

Producing a terminal error accuracy of less than half a mile after covering distances the equivalent of more than halfway around the world (bearing in mind that the system was in use many years before the advent of satellite navigation systems), it was justifiably considered by some to be the most outstanding piece of equipment to come out of the entire Senior Crown programme. The ANS combined data from an inertial platform with a time datum supplied from a chronometer accurate to within 5ms. Position updating was achieved automatically by astro-tracking six of the 52 most prominently visible stars at any time by day or night. The stars were computer catalogued in an ephemeris memory that could be continuously cross-checked for track position referencing. Scanning the celestial bodies sequentially, through a pre-programmed tracker mechanism mounted on a gimballed platform on top of the nav unit, the astro-tracker provided passive, refined location information.

When the autopilot was coupled to the ANS through the auto nav function switch, the aircraft could be flown automatically and precisely on a predetermined flight path. The pre-planned route (worked out by highly experienced navigators) was electronically loaded via a Milar tape into the ANS's computer memory a few hours prior to take-off. Inflight modifications could be made by the RSO using his control and display panel. During flight, the computer-sequenced plan directed the aircraft from one destination point (DP) to the next.

Two further features of the ANS included ground reference position updating through the forward-looking view sight, and sensor monitoring by reference to control point (CP) actions; CPs were pre-determined track points, programmed into the ANS, that would activate or deactivate reconnaissance sensors and served to alert the RSO that the system was about to turn on, that the system had functioned correctly, and that programmed activities were being automatically carried out.

Although the A-12 was highly advanced, its cockpit instrumentation was conventional. The hooded view scope can be seen at the top of the picture. (Lockheed Martin)


BAILOUT
CHUTE
ALERT
RSO EJECTED
FIRE LEFT NAC
FIRE RIGHT NAC
IVSI
VERTICAL SPEED
FUEL POUNDS X 1000
DISPLAY MODE SEL
SURF LIMIT RELEASE PULL
TRIM
AFT TRANSFER

The SR-71's front cockpit betrays its 1960s' vintage. (Paul F. Crickmore)

The ANS was backed up by a Singer-Kearfott SKN-2417 INS with a circular error probable (CEP) of 1nm per hour. This replaced the SR-71 gyro flight reference system (FRS) in June 1982. The earlier system had no navigation capability and provided heading and attitude information only.

At the heart of the new unit was an inertially stabilized platform (four gimbals for all-attitude operation, vertical and azimuth gyros and three sub-miniature pendulous linear accelerometers). Located in the so-called R-bay, the gyro-platform provided navigation data to a control panel located in the RSO's cockpit.

MISSION RECORDER SYSTEM

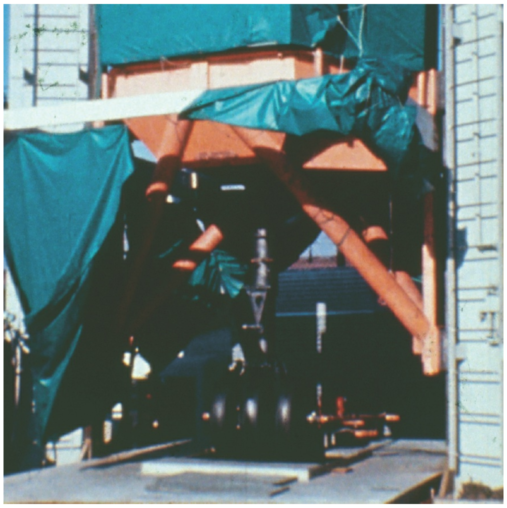
The mission recorder system (MRS) was an airborne mission and maintenance data-recording system used to store up to 12 hours of monitored aircraft and system performance information. In addition, the MRS recorded the actions of the reconnaissance sensors and navigation systems, as well as all inter-cockpit and radio voice transmissions.

The purpose of this crash-survivable system was to identify failures, impending failures, and sub-standard system performances for maintenance purposes or accident analysis. Data collection was achieved through multiplexing switches within the MRS, which sequentially shared analogue and digitized signals at a sample rate of once every 3 seconds. Once activated, the system operated continuously and automatically.

After a mission, the recorded data was copied from the ACR-500 recorder-assembly on the aircraft using a Mobile Ground Formatter Unit (MGFU), which created a computer-compatible tape (CCT) of non-voice data. A portable tape copy unit (TCU) was used with the MGFU to copy the crew's voice audio recording. The table below summarizes the number of signals monitored by the MRS within each aircraft system.

Engine	16
Hydraulic system	13
DAFICS	58
Electrical system	24
MRS	18
ANS	100
ECS	16
Miscellaneous	20

VELOCITY/HEIGHT, VELOCITY/RADIAL SYSTEM



A main undercarriage undergoes drop tests. The unit featured a hollow-axle arrangement that enabled any wheel to be changed without removing the other two. (Lockheed Martin)

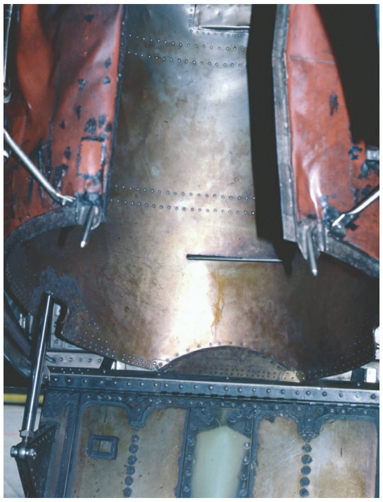
The 32-ply main tyres were made by B. F. Goodrich and filled with inert nitrogen gas to a pressure of 415psi. Their walls were impregnated with aluminium powder to reflect heat while they lay retracted in the wheel well. They were good for 15 full-stop landings and cost $2,300 each. (Paul F. Crickmore)

The Velocity/Height (V/H) ratio, or Forward Motion Compensation (FMC) system, produced signals scaled electrically through the V/H bus to represent the angular rate of motion between the aircraft and terrain below. Signal sources for the system were the ANS and the V/H indicator in the RSO's cockpit. These signals were scaled at 0.2V (DC) per milliradian per second (mil/s), and caused the reconnaissance camera's mirror or film platen to move in such a way that the target image remained stationary relative to the aircraft (and therefore sharp), during film exposure.

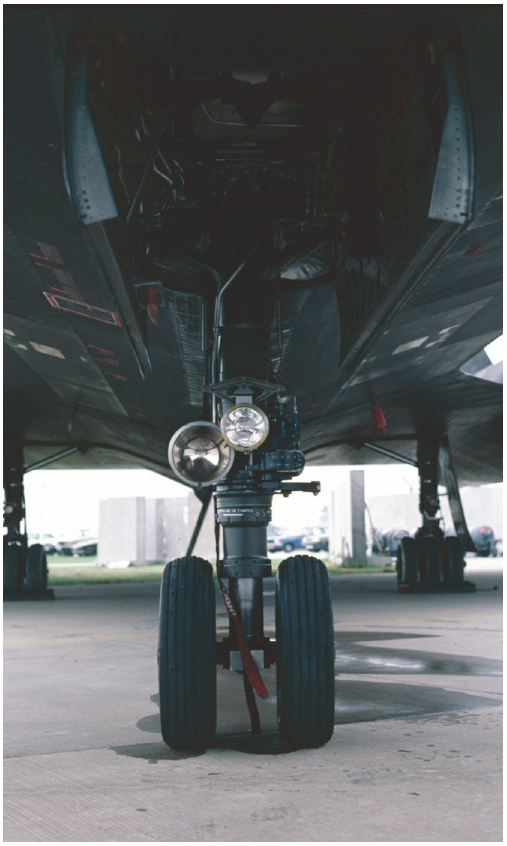
The Velocity/Radial (V/R) distance was also used to drive the camera's motion compensation mechanism, based upon the actual distance between the aircraft and its target. For example, when the SR-71's Technical Objective Cameras (TEOCs) were looking out at an angle of 45°, their slant range was significantly greater than the aircraft's altitude and therefore required an element of FMC. The required FMC was calculated by dividing the aircraft's altitude by its true airspeed. For example, at 77,500ft and 1,850kt true airspeed (KTAS), V/H = 42mil/sec.

The Sensor Event/Frame Count system also aided surveillance interpretation. It correlated time, position, altitude and heading while the TEOCs were in operation, using the ANS mission recorder system and a signal sensor processor to convert event input signals into 6ms-wide event marker pulses that were monitored by the ANS. On receiving an even marker pulse, the ANS activated a frame-count register associated with a particular sensor. This data (with precise location information) was recorded by the mission recorder system.

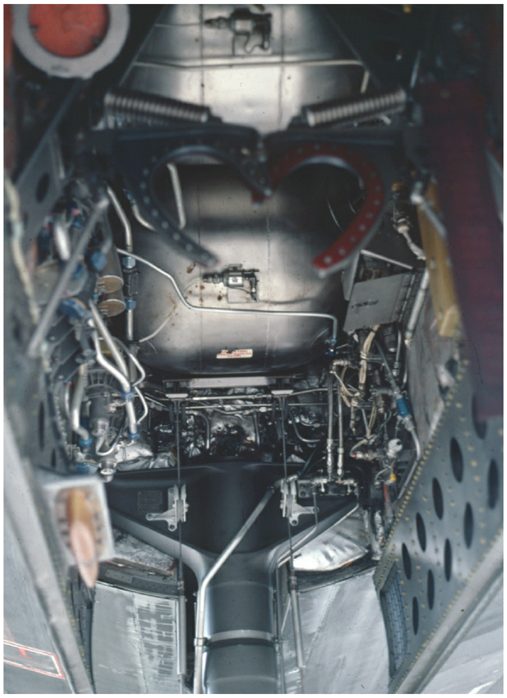
The RSO could manually operate and control all reconnaissance sensors, but in practice these were normally fully pre-programmed for automatic turn-on/turn-off and changing 'look angles' in order to frame hundreds of separate targets of interest. A manual exposure control panel enabled the RSO to remotely control camera exposure to take account of lighting conditions (brightness and reflectivity). This was graduated in degrees of sun angle, with reference indices for low, normal, high and very high terrain reflectivity. Such changes were made by regulating DC voltage between 10 and 38V for sun angle settings between 5 and 90°.



A titanium shroud was fitted inside each main gear well to help protect the undercarriage tyres from heat damage during sustained high-Mach flight. (Paul F. Crickmore)



The nose gear bay was kept cool by the aircraft's environmental air system and no further protection was required for the nose wheel tyres. (Paul F. Crickmore)



A pair of 105-litre nitrogen dewars was carried in the nose gear bay to pressurize the fuel system and purge the tanks of vapour as fuel was burnt off. (Paul F. Crickmore)

COMMS AND NAV EQUIPMENT

The SR-71's communications and avionics equipment comprised an AN/AIC-18 interphone system for crew inter-communication and crew-to-groundcrew interphone communication. A COMNAV-50 UHF radio provided voice transmission and reception on any of 7,000 channels in the P-band frequency range, and a direction-finding capability. The system operated in two modes: 'internal', which was compatible with other types of UHF radio, or 'external', wherein coded communication was possible only with other COMNAV-50 radios.

Operating in the 'external' mode the system offered high resistance to jamming, in addition to security and a range-measuring capability. Two independent UHF radio sets were provided, designated UHF-1 in the front cockpit and UHF-2 in the rear cockpit. A modem control panel in the RSO's cockpit controlled the coding of 'external' signals and discrete selection of the ranging partner. An AN/ARA-48 automatic direction finding (ADF) antenna was used in conjunction with the UHF radio system, automatically pointing to emissions emanating from compatible equipment transmitting on the same frequency, so that with the radio operating in 'external' mode, the ADF function would operate provided that it was within the detection range of a similarly programmed COMNAV-50. The system had a range of up to 200nm.

An AN/ARC-186(V) VHF radio provided AM transmissions and reception from 108.000 to 151.975MHz. Frequency spacing was 25KHz and 20 channels could be pre-set in addition to the emergency 'guard' frequency (121.5MHz). Either narrow or wideband operation was possible, but this had to be pre-set by maintenance personnel. The FM capability of the radio was not operative.

For long-range voice communication, the SR-71 was equipped with 618-T and AN/ARC-190C(V) HF radios. The modes of operation for the 618-T were single sideband (SSB) or amplitude modulation (AM). The frequency range was 2 to 30MHz, tunable in 1KHz steps. The ARC-190 received and transmitted on 280,000 frequencies in a band from 2 to 29.9999MHz, spaced at 100Hz. Modes of operation were upper and lower sideband, AM and continuous wave; the aircraft's pitot boom was the antenna for both HF radios.

A 51RV-1 ILS receiver supplied signals to the bank and pitch steering bars, the glideslope indicator on the attitude director indicator (ADI) and to the course deviation indicator (CDI) on the pilot's horizontal situation indicator (HIS), enabling him to conduct instrument landings. The receiver operated on 20 frequencies; localizer frequencies ranged from 108.1 to 111.9MHz, while glideslope frequencies ranged from 329.3 to 335.0MHz. The correct glideslope frequency was automatically tuned when the localizer frequency was selected.

The SR-71 was equipped with two IFF transponders, an AN/APX-108(V) (W/SB R-2668) and a WILCOX 914X-2 IFF (W/O SB R-2668). The system included altitude reporting (suppressed by the RSO above 60,000ft), selective identification and emergency reporting features. Mode 4 provided an encrypted IFF capability. Two beacons, a G-band and an I-band, were provided to aid radar tracking when the SR-71 was participating in special tests.

Finally, for non-covert flights the aircraft was equipped with an AN/ARN-118(V) TACAN, used with ground stations and cooperating aircraft.

SENSOR SYSTEMS

The first operational SR-71 mission, flown under the code name Giant Scale, was performed from Kadena by Maj Jerry O'Malley and his Reconnaissance Systems Officer (RSO) Maj Ed Payne in aircraft '976, on 21 March 1968. For this historic sortie, the aircraft was configured with a high-resolution radar (HRR) in its nose section.

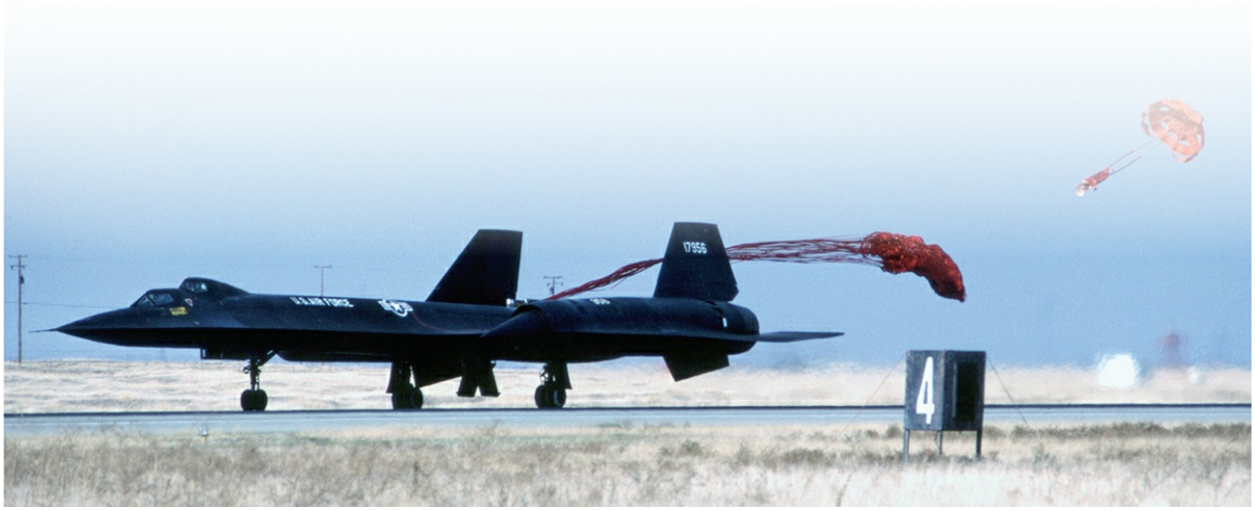
Codenamed PIP (Product Improved Radar) by the Air Force, it had been developed and built in 'the black' by Goodyear Aerospace, which designated it 531 or GA-531, the numbers signifying the block number it assigned to identify the SR-71's drawings. The antenna received X-brand Doppler phase information, which was stored on a recorder housed in the forward right mission bay. This was then transferred onto a continuous 4in.-wide map film via a ground-based optical correlator; the end result was an image similar in appearance to that obtained by a camera with a ground resolution of about 10ft.

A Fairchild Camera Company F489 terrain objective camera (TROC) was installed in the SR-71's so-called C-bay. Equipped with a 6in. focal length lens, this wide-angle mapping camera operated throughout the sortie, producing a single overlapping exposure of the terrain directly below; its 663ft of film, weighing 135lb, could photograph a strip 7,800nm long at 55 per cent overlap. The developed images enabled photo interpreters to cross-check the aircraft's position and provide additional ground cues in relation to targets photographed by the other sensors.

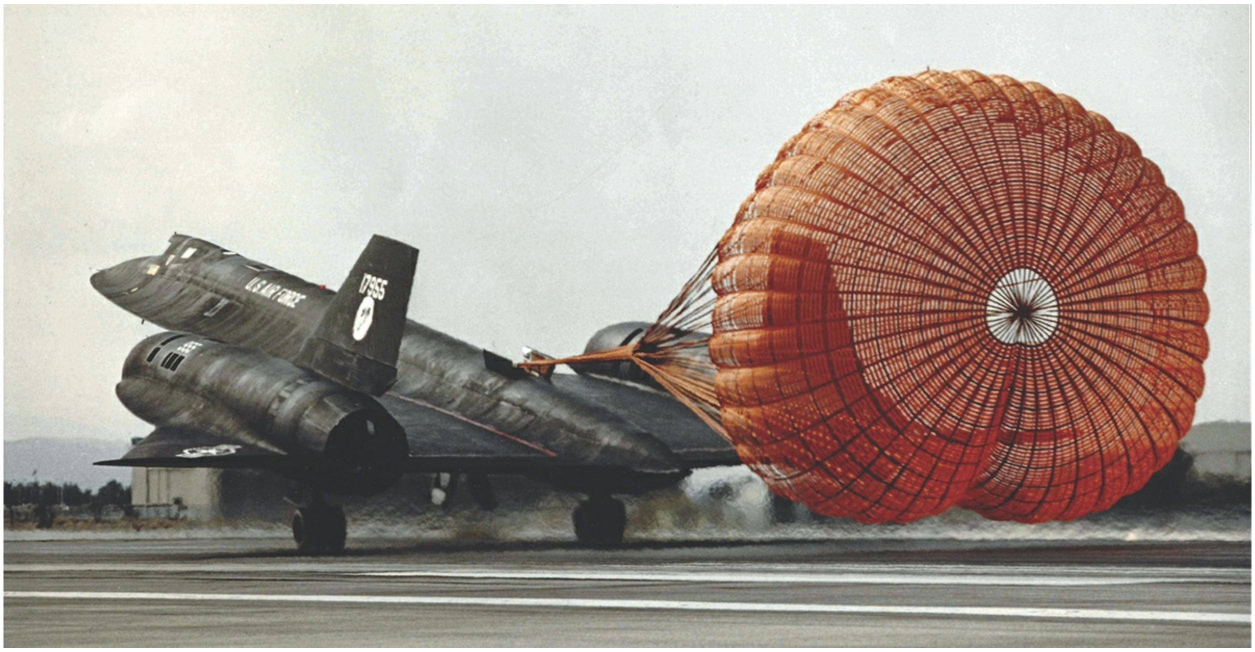
Bays P and Q held close-look Hycon HR-308B variable pointing angle, high-resolution, narrow-field framing technical objective cameras (TEOCs), also known as Tech cameras. They were mounted horizontally but a tilting beryllium mirror in the camera's scan-head enabled viewing of targets below and out to about 45°. The camera touted a 48in. focal length lens that imaged onto fine grain film producing a 9½in-square frame; maximum film capacity was 1,500ft, producing 1,800 usable frames per camera per flight and track coverage of about 2,000nm, the nominal ground area photographed was about 2½ miles square.

The TEOCs had four modes of operation. Burst mode took a burst of 10 photographs at a rate of about one per second. Stepping mode slewed the camera head back and forth, four digits either side of a commanded look angle, to provide wider coverage of a given area when a target's precise location was unclear or the area of interest was wider than the normal frame width. Two overlap modes were also available: one was timed to provide a 55 per cent overlap of each consecutive frame, the other produced a 10 per cent overlap between frames.

The system was activated automatically by the ANS or manually by the RSO. The camera was available in two models: HR-308B and HR-308C. The B model had two versions, the -11 and -21. Except for passive vibration isolation, the HR-308B was unstabilized, while the HR-308C was actively stabilized in pitch, roll and, at higher look angles, yaw.



An SR-71B pilot trainer demonstrates the brake parachute system. A 42in. 'chute removed the brake parachute's cover, followed by a 10ft extraction 'chute that deployed the main. (Lockheed Martin)



The 40ft main ribbon brake parachute provided rapid deceleration – some crews claim that this was in the region of -2G. (Lockheed Martin)

On that historic, first operational mission, aircraft ’976 also carried two Itek Corporation HR-9085 operational objective cameras (OOCs). These were also mounted horizontally and used a mirrored scan head; they were located in bays S and T. These high-resolution, three-dimensional panoramic cameras had a focal length of 13in. and a maximum capacity of 3,300ft of 70mm film, sufficient to cover 3,600 frames, with alternate forward and aft exposures of the terrain below and to the side of the aircraft’s track. Each camera had a lateral coverage of 45° and total track coverage of about 1,500nm; they were manually activated by the RSO.

HRB-Singer produced the little-known HRB-454 IR sensor system for the Senior Crown programme, recording out to 45° either side of the aircraft’s flight path on 100ft of 70mm film. Having undertaken its first SR-71 Cat II flight test on 3 May 1966, it completed 49 IR test flights, but was discarded early in the aircraft’s operational career.

At 02:00pm on 5 April 1972, Randy Hertzog and his RSO John Carnochan launched ’980 from Kadena equipped with an optical bar camera (OBC) in the nose section for the system’s first operational test. This panoramic camera was fitted initially with a 24in. focal length lens. It was built by the Itek Corporation and obtained high quality horizon-to-horizon imagery focused on fine-grain black and white film with an ISO rating of just 8. So successful were the results that by the end of the year the Strategic Reconnaissance Center (SRC) directed that the OBC be used whenever weather over South-East Asia permitted and that on days of heavy cloud cover the HHR unit should be substituted, an operation that took maintenance about 16 hours to complete. Having proved its worth, the OBC went on to replace the OOC units as a means of collecting panoramic coverage.

On 6 December 1973, Palmdale’s flight test bird ’955 completed a Functional Check Flight (FCF) with the OBC fitted with a new 30in. focal length lens. Over the next six weeks, seven further flights confirmed the outstanding resolution achieved by the new lens and production models were made available to the operational fleet.

The OBC was contained inside a shroud mounted on a hatch. An extension of the cold air supply in the forward chine bay directed refrigerated air into the shroud above and on each side of the rotating lens system; warmed air exhausted into the nose compartment. To prevent the OBC lens system from being over-cooled, electric heaters in the shroud ensured that the temperature was maintained at approximately 40°C.

The film was supported by air that was ducted through the canopy seal supply line, and although the camera wasn't stabilized, it was equipped with vibration isolation and a damping system compatible with its environment in the nose. The lens system had a fixed aperture and was mounted on an 'optical bar' that accommodated the lens and two mirror assemblies used to create the folded optical path.

In operation the optical bar rotated continuously around its longitudinal axis. Film exposure was accomplished via a scanning slit shutter while the bar and film were in motion. The width of the slit adjusted automatically to compensate for varying degrees of brightness and the velocity/height (V/H) ratio. Full coverage was obtained through a scan angle of 140°, ie 70° either side of the aircraft's track, with a field angle along the flight path of approximately 8°. Aircraft FMC was provided during frame exposure when the V/H ratio was between 35 and 45mil/s; otherwise the FMC was automatically set at 40mil/s if the applied signal fell outside that range.

A data block in each frame recorded mission information, frame number and camera fore/aft or vertical orientation. The camera's cycle rate was controlled automatically by the frame overlap requirement of each of the three available modes of operation and by the V/H FMC. The film used was either 3414 or 1414 and the operating mode could be selected in flight.

SIDE-LOOKING AIRBORNE RADAR (SLAR)

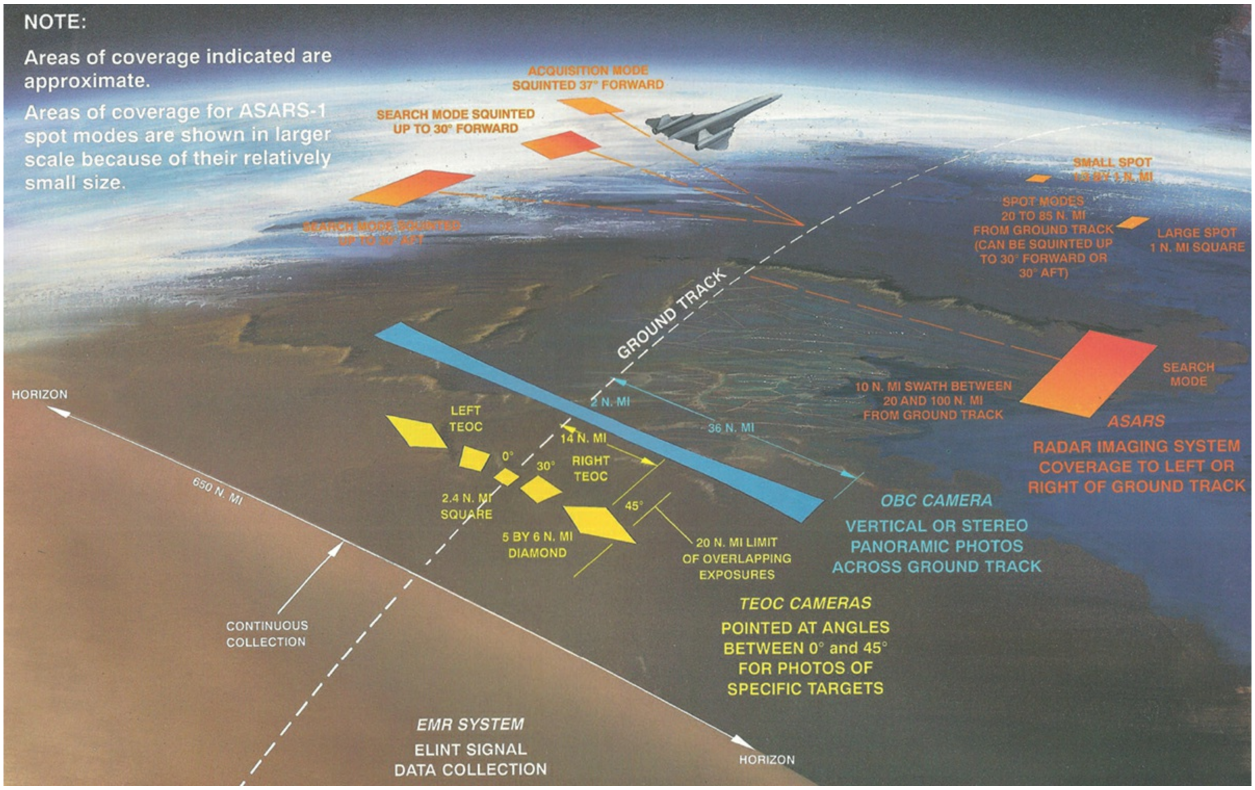
The final major sensor upgrade intended to become operational on the SR-71 prior to the end of the Vietnam War was the Capability Reconnaissance Radar (CAPRE). This was an improved High-Resolution Radar (HRR), designed to replace the PIP unit. Manufactured by the Goodyear Aerospace Corporation, the prototype underwent intense flight trials by the two flight crews of Det 51, Air Force Logistics Command (AFLC), at Palmdale. Its first test flight was undertaken by Merv Evenson and Coz Mallozzi in '955 on 27 April 1972 and was successfully completed on 11 July, after 13 sorties in 28.8 flight hours.

The prototype was then transported to Det 1 at Kadena AB where it received its baptism of fire in ’975. It was flown by Majs Bob Cunningham and his RSO George ‘GT’ Morgan, on 12 August 1972. However, due to various technical problems, the anticipated deployment of production units on the three SR-71s participating in the June 1973 deployment to Kadena was delayed and PIP units were again used.

As national intelligence users, particularly the US Navy, were made aware of the vastly improved resolution generated by the new CAPRE system (a synthetic aperture radar system), demands for more SR-71 missions increased appreciably. In fact, 1980 saw the largest number of operational missions flown since the height of the Vietnam War in 1972.

The CAPRE system could be used in conjunction with the Radar Correlator Display (RCD) to produce an inflight display for navigation purposes. Its main function, however, was to illuminate ground targets that were then recorded onto a film strip on two recorders housed in the aft portion of the right forward mission bay, or L-bay. Range marks and data block information were automatically superimposed onto the film and the unit could be programmed to cover a strip either 10 or 20nm wide, either side of the aircraft’s track, with the near edge of the swathe between 10 and 70nm from the aircraft. On the downside, CAPRE could only be used in straight and level flight. Two modes of operation were provided: Automatic, where the system was controlled by the ANS or Manual, by the RSO.

The RCD was a self-contained unit located in the forward portion of the aft cockpit. It operated in conjunction with, but was independent from, the radar recorders. The

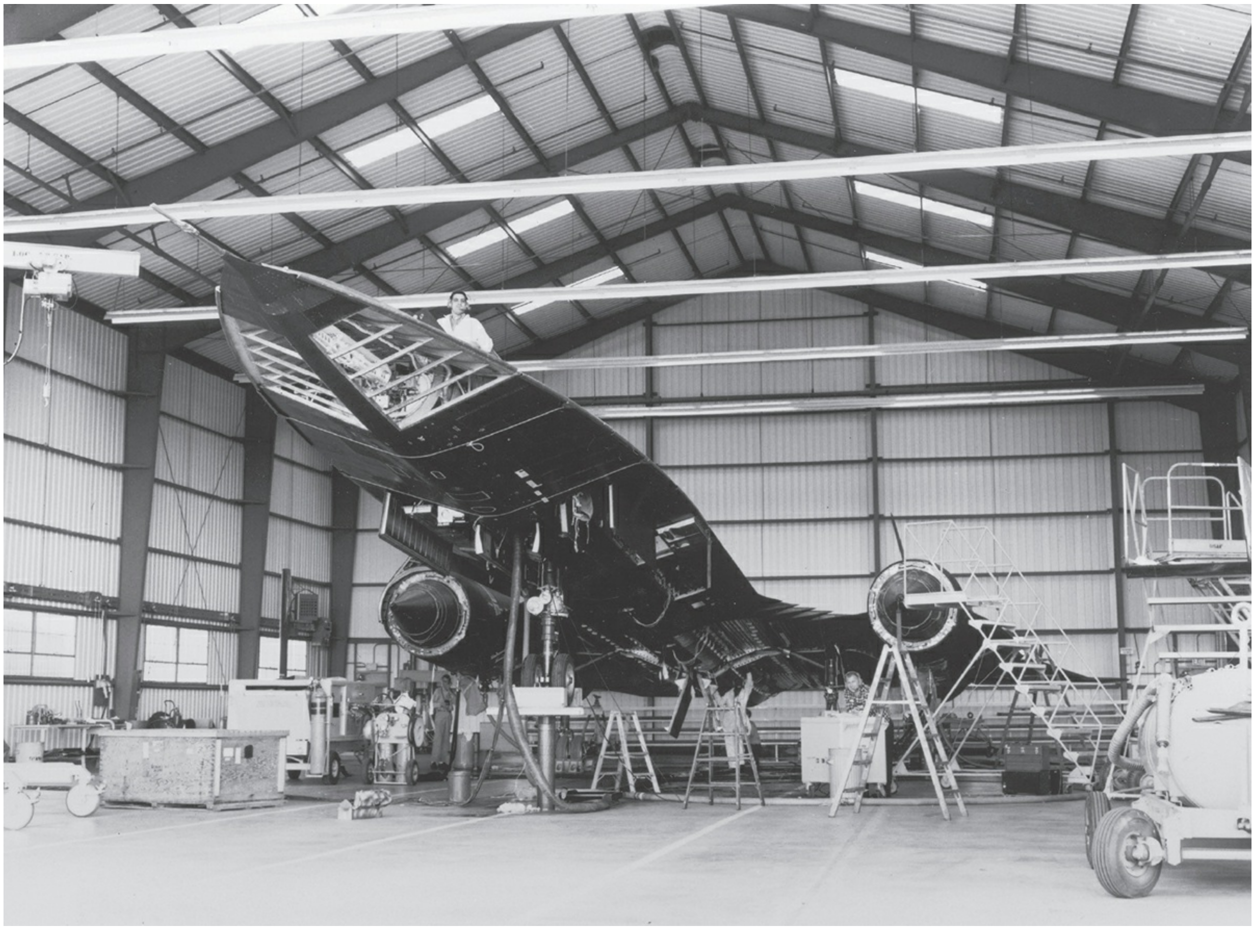

NOTE:
Areas of coverage indicated are approximate.
Areas of coverage for ASARS-1 spot modes are shown in larger scale because of their relatively small size.
ACQUISITION MODE SQUINTED 37° FORWARD
SEARCH MODE SQUINTED UP TO 30° FORWARD
SEARCH MODE SQUINTED UP TO 30° AFT
SMALL SPOT 1/3 BY 1 N. MI
SPOT MODES 20 TO 85 N. MI FROM GROUND TRACK (CAN BE SQUINTED UP TO 30° FORWARD OR 30° AFT)
LARGE SPOT 1 N. MI SQUARE
GROUND TRACK
SEARCH MODE
10 N. MI SWATH BETWEEN 20 AND 100 N. MI FROM GROUND TRACK
ASARS
RADAR IMAGING SYSTEM COVERAGE TO LEFT OR RIGHT OF GROUND TRACK
HORIZON
2 N. MI
36 N. MI
LEFT TEOC
14 N. MI
0°
30°
RIGHT TEOC
2.4 N. MI SQUARE
45°
5 BY 6 N. MI DIAMOND
20 N. MI LIMIT OF OVERLAPPING EXPOSURES
OBC CAMERA
VERTICAL OR STEREO PANORAMIC PHOTOS ACROSS GROUND TRACK
650 N. MI
CONTINUOUS COLLECTION
TEOC CAMERAS
POINTED AT ANGLES BETWEEN 0° and 45° FOR PHOTOS OF SPECIFIC TARGETS
EMR SYSTEM
ELINT SIGNAL DATA COLLECTION
HORIZON

Approximate synoptic data collection coverage from 80,000ft. (Lockheed Martin)

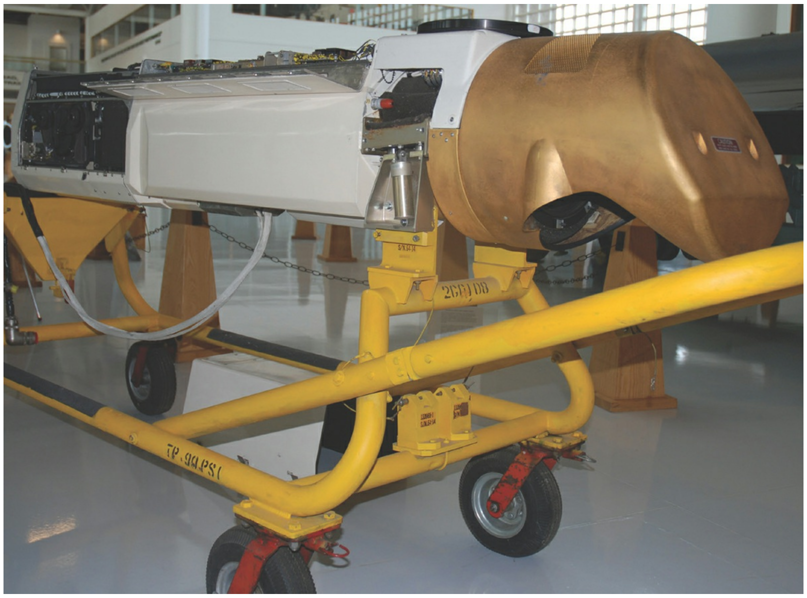
RCD operated when the SLAR was in operation, since it depended on SLAR Doppler phase history video to produce the inflight display for navigation. The display moved downwards at a rate proportional to the aircraft's ground speed and was normally 50s. (25nm at cruise speed and altitude), behind the aircraft's real-time position. The RCD map display was 15nm wide and had to be stopped by the RSO for target evaluation and the determination of navigation fix-point error.

The final radar system developed and deployed on the SR-71 fleet before programme shutdown was the Loral Advanced Synthetic Aperture Radar System (ASARS), which catapulted radar-generated ground mapping into a new dimension. First deployed operationally to RAF Mildenhall on 9 July 1983, it is believed that the system had a resolution of less than 12in. at nadir from 80,000ft.

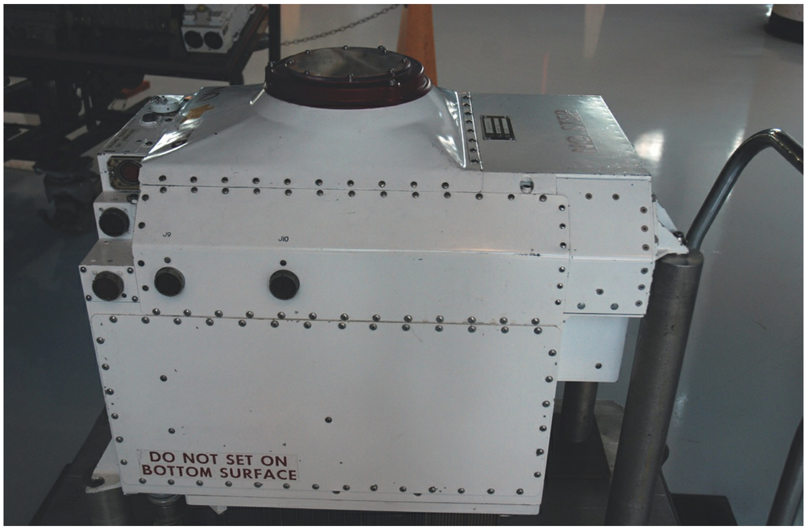
As a note of interest, all three ground-mapping radars built for the SR-71 emanated from the same production facility; ownership however changed several times over the years. The first system, PIP, was built by Goodyear, which also built the CAPRE/HRR system, but the company was subsequently bought by Loral. Under that name, ASARS was developed and fielded. In 1996 Lockheed Martin bought Loral's imaging business, selling it to BAE Systems in 2000. Fairchild, which had also been responsible for manufacturing SR-71 camera equipment, sold its imaging portfolio to Loral in 1980 and today BAE continues in the business of high-end sensors under the resurrected Fairchild Imaging brand.



Removed panels on the underside of this SR-71's nose reveal the antenna for the CAPRE high-resolution ground-mapping radar. (Lockheed Martin)



An SR-71's Hycon HR-308B technical objective camera. Note the beryllium mirror in the scan head, which was angled to photograph targets relative to the aircraft's position. (Stewart Bailey via Paul Crickmore)



The Nortronics Division ANS updated the SR-71's inertial navigation system automatically by constantly astro-tracking six of the 52 most prominently visible stars. (Stewart Bailey via Paul Crickmore)

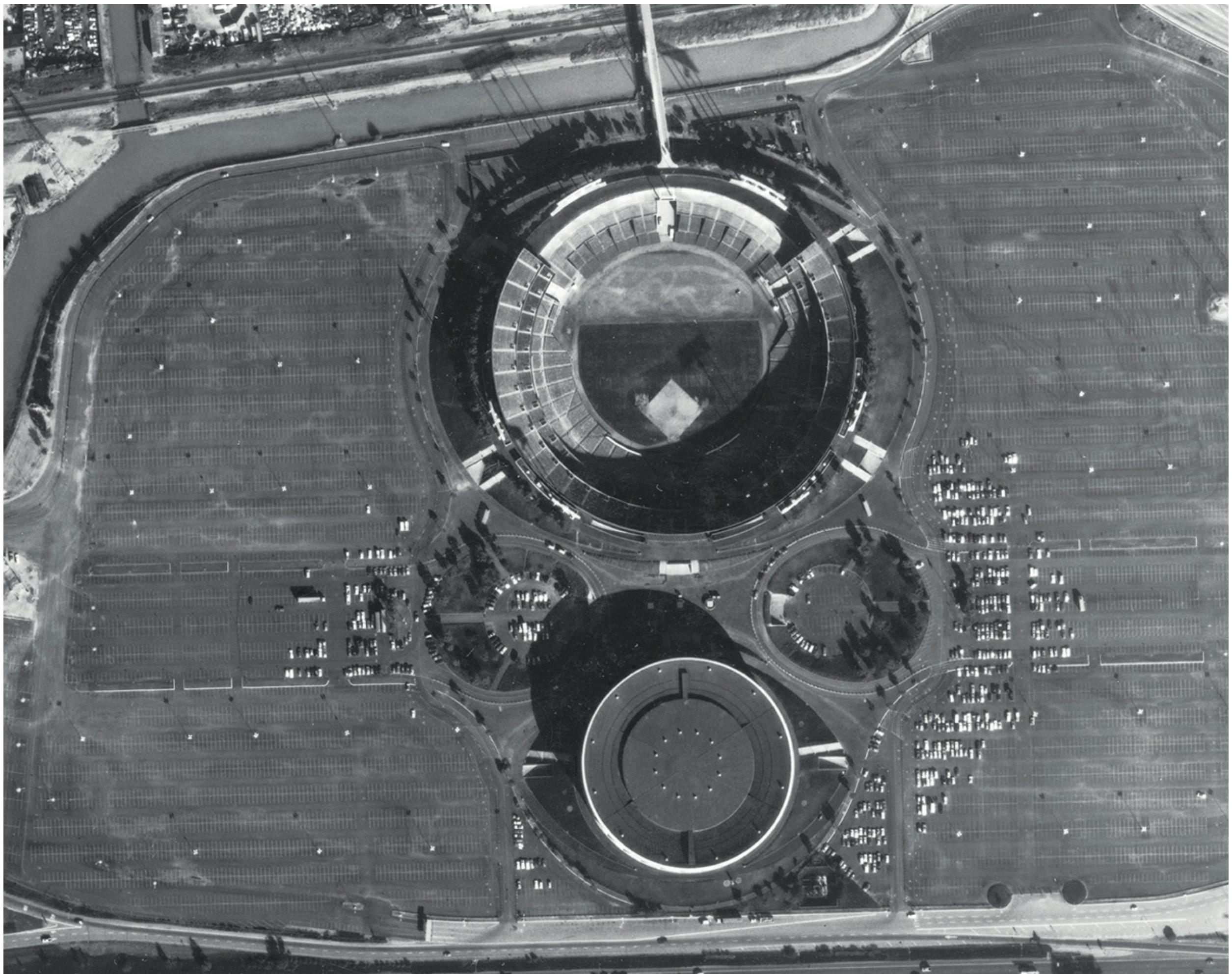
SIGINT RECEIVERS

In May 1969, the SR-71's electromagnetic reconnaissance system (EMR), built by Airborne Instrument Laboratories, was deployed for operations. The system was interfaced with the ANS and MRS for data collection and with the IFF, TACAN, SLAR and DEF systems to prevent received intelligence being masked by transmissions from those systems.

To provide meaningful data it was necessary that the ANS was fully operational even though the EMR operated independently. Once activated by the RSO, it was an entirely automatic, passive collection system and performed two search functions simultaneously, special search and general search. Special search was based upon pre-flight instructions in the ELINT Improvement Program (EIP) computer that designated emitters of special interest. When a received signal matched the designated emitter, a monitor receiver was automatically tuned to that signal for a pre-programmed period, and the signal pulses were passed to special detectors and recorded on tracks of the continuous analogue recorder as video signals to be evaluated using specialist equipment after landing.

The general search function searched the frequency spectrum from 30MHz to 40GHz. This spectrum was divided into six bands, all of which were searched simultaneously. Every emitter signal received in the bands was recorded on the digital recorder by way of time, frequency, direction, pulse width and amplitude.

The continuous analogue recorder was a 14-channel Ampex Model AR-1700, a wide band magnetic tape recorder that stored special search signals, ELINT data from the on-board DEF systems and maintenance data. The recorder could be operated automatically by the EIP system and/or manually by the RSO.



A baseball ground photographed from 80,000ft by an SR-71's optical bar camera during a stateside training mission. The 4in-wide white lines delineating car parking spaces are easily disernable when the image is enlarged. (USAF)

The tape transport operated at 60 or 120in./s. A 14in. reel supplied 9,200ft of 1in. magnetic tape that provided 30 or 15 minutes of recording time per flight.

The increased capability provided by the EIP generated further mission requests from SAC for information required for its Single Integrated Operational Plan (SIOP) and also from the Defense Intelligence Agency (DIA), CINCPAC, Military Assistance Command Vietnam (MACV) and the Commander United States Forces Korea (COMUSKOREA).

The capability also led the Joint Chiefs of Staff (JCS) to direct SAC to execute peripheral SR-71 ELINT sorties of China, the USSR, North Korea, the Taiwan Straits and Sea of Japan, in addition to overflight missions of all high threat areas of North Vietnam. The increase in aircraft utility was such that on 18 December 1970 another SR-71 was added to the Kadena detachment, and for the next two and a half years it operated four aircraft.

DEF SYSTEM

The SR-71 did not carry defensive weaponry, but was instead protected electronically (see Appendix 3). Electronic Counter Measures (ECM) technologies advanced and changed rapidly, so the SR-71's defensive electronic (DEF) systems required constant updating and modifications throughout its almost 30 years of operational service. These modifications at that time were derived mainly from the 'ELINT take', captured by RC-135V/W Rivet Joint and RC-135U Combat Sent, U-2, SR-71 and other similar platforms. The signal characteristics were subsequently analysed by specialists of the National Security Agency (NSA), before being incorporated into the Electronic Order of Battle. These 'electronic finger-prints' were then fielded to the appropriate ECM manufacturers, who were tasked to either modify existing systems or produce a new one, capable of protecting the transporter platform. In the case of the SR-71, the new equipment or modification would then have been flight tested by the two test crews and dedicated flight test SR-71, of Det 51/6, at Palmdale. If proven to be effective, the system would then have been approved for roll-out to the operational fleet. All controls required to operate the DEF systems carried by the SR-71 were located on a single panel on the RSO's left console.

An Oxcart paper dated 26 September 1967 and declassified in 2007 provided a detailed comparison of the A-12's DEF systems with those that equipped the SR-71 at the time. Two prototype systems had been built for the SR-71 and testing was due to begin in October 1967, after which the production model was to be defined. The primary system covered frequencies in the S- and C-bands, required 3–10kW of power output and used deceptive noise, false targets in the main lobe and beacon receiver jamming techniques to defeat the SA-2 and AAA threat (the latter is difficult to envisage given the aircraft's operating altitude).

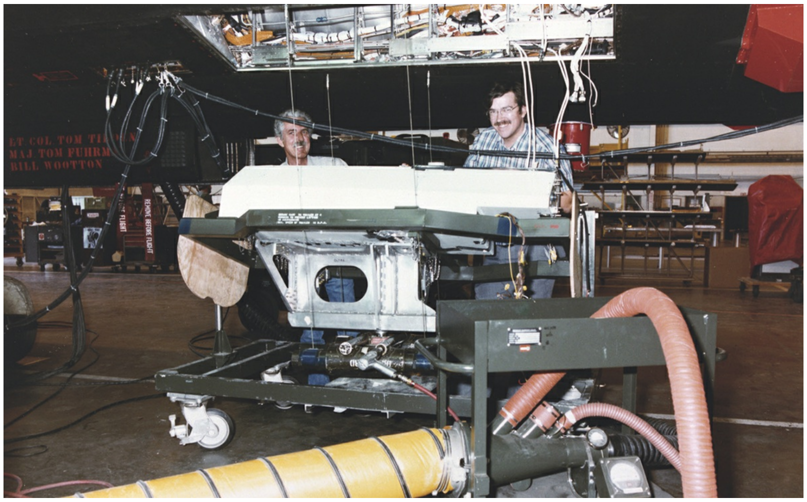
DEF H was an extremely effective and powerful noise jammer. (Mike Hull via Paul Crickmore)

Five SR-71s at Beale were due to have a piece of equipment known as CFAX installed by 18 November 1967. This was to operate in the X-band, require 1kW of power output and employ techniques to defeat the SA-3 and air intercept threat. It generated false targets, and employed angle deception and countdown techniques.

Finally, an interim fit using an APR-27 and System 13C was fitted to three Beale SR-71s at the time of the report, and three more were scheduled by 18 November 1967. Both systems operated within the S- and C-bands against SA-2s; the APR-27 element provided threat alarm by detecting the presence of Fan Song radar activity, which, if necessary, activated System 13C, which used angle deception to defeat the missile threat. System 13C was carried in place of the left TEOC or ELINT package.

Later, an arbitrary alphanumeric system was used to designate the various elements of the DEF system. In March 1969, System E became operational, followed by systems F and G in June and December 1970, respectively. In April 1972, a Special ELINT Beacon Receiver (SEBER), known as System G, was deployed for operational testing on selected Giant Scale missions being flown from Kadena AB. It was designed specifically to receive the modified beacon transponder signals of SA-2s and alert the RSO of their receipt.

The final DEF configuration included systems A2, C2, H and M. DEF A, the forerunner of A2, was developed in response to anticipated improvements made to Soviet airborne threats. It was installed in '955 in April 1971, and following initial tests Merv Evenson and Red McNeer deployed the aircraft to Eglin AFB on 7 July. During the following two weeks, Dick Gerard and Ron Selberg joined their colleagues and together, a total of 34 passes were made during ten hours of flight time in a series of intense evaluations. Upon return to Palmdale, further tests 'against' F-4s were conducted throughout September and October, which were used to adjust the systems' thresholds. These last tests were completed by Palmdale on 7 October 1971, after which DEF A was signed off and production sets ordered and installed on the operational fleet some months later.



DEF A2C provided the SR-71 with electronic defence against airborne threats. (USAF)

Staying ahead of the constantly evolving airborne threat, A2 was installed in '955 in early October 1973. On 17 October, under the deployment codenamed Black Knight, Merv Evenson and Cos Mallozzi positioned '955 to Griffiss AFB. Over the next five weeks, seven evaluation sorties were flown in over 14 hours of flight time, the sorties being shared with Tom Pugh and Ron Selberg, before the aircraft was returned to Palmdale on 20 November.

DEF A2 was an ECM jammer designed to protect the aircraft from airborne threats operating in the X-band frequency. It consisted of two sets of receive and transmit antennas, and a gaseous nitrogen system to pressurize the transmit waveguides. The receive antennas were located in 'blisters' on the left and right sides of the nose chine and identified the threat as coming from below the aircraft in either the left or right forward quadrants. A2's transmit antennas protruded slightly from the lower surfaces of the chines opposite the pilot's cockpit. The DEF A2 system was interfaced with the MRS, radar and EMR and, when mission requirements dictated, the received signals could be recorded for later analysis on the AR-1700.

Whilst Palmdale's dedicated platform '955 underwent Programmed Depot Maintenance (PDM), for 12 months, SR-71 '975 joined the flight test team on 25 October 1979. Its primary task whilst at Palmdale was to undertake flight test modifications and updates made to DEF A2. Accordingly, on 11 December 1979, Cal Jewett and RSO Bill Frazier completed seven subsonic passes during a flight lasting two hours 30 minutes. Three days later Jim Sullivan and GT Morgan completed six subsonic passes. However, due to a bad fuel leak, testing did not begin again until 8 January 1980, when Cal and GT were scheduled to have a US Navy F-4J fly against the new DEF system. Unfortunately, the F-4's radar went down after its second pass, so the sortie was aborted. Three days later, Jim and Bill got good results after F-106s from Aerospace Defence Command completed seven passes against '975 and its new 'black box'. On 15 January the modified A2 system successfully defended the Blackbird against six passes made by USAF F-4Es and on 18 January, it proved itself yet again, this time against six passes made by Navy F-4Js. On 22 January, more success was recorded against three passes by F-4Es whilst both platforms were at supersonic speeds. A further 15 passes during two final sorties were made; the last against F-4Es and F-106s on 8 February, after which the system was declared ready for the operational fleet

DEF C2 worked in both the L and UHF-band of frequencies, as it had to de-conflict with the IFF and TACAN. DEF C2 worked in conjunction with DEF H to protect the SR-71 from SAM threats. It consisted of a receiver, band antenna, band-pass filter, power relay and electrical and coaxial cables. Receipt of an L-band signal from DEF C2 generated a warning for the RSO. If a lock-on or missile launch occurred, DEF H jamming could be triggered. Improvements to this system known as DEF C2B were test flown on 9 September 1981 by Bob Helt and JT Vida. Fourteen hot (supersonic) passes were flown over a test facility; however, the modified system did not work well. A week later, Cal Jewett and JT completed 20 passes. These were followed by a further nine passes by Bob Helt and Bill 'Flaps' Flanagan on 23 September 1981, after which the system was cleared for use operationally. Fifteen months later, '955 was equipped with a new DEF C system, flown for the first time on

15 December 1982 by Tom Tilden and Bill 'Flaps' Flanagan during a flight lasting four hours 30 minutes. Another flight relating to the new DEF unit was flown on 10 February 1983 by Bob Helt and JT.

U.S. AIR FORCE
17955
955
3783
VX4
NAVY

The SR-71s crews of Det 6 at Palmdale had a mutually beneficial relationship with VX-4, the US Navy T&E unit stationed at NAS Point Mugu. The SRs were ideal high-performance targets for Navy evaluations and the Navy F-4s were at hand when various airborne DEF systems required flight testing on the SR-71. (USAF)

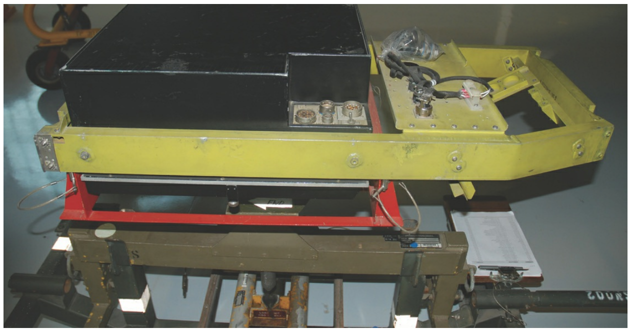
DEF H was first flown in '955 on 30 July 1974, but exhaustive flight tests trials began when '955 was positioned to Eglin AFB on 20 August by Tom Smith and Coz Mallozzi. The Det 5 crew were joined by their colleagues Tom Pugh, Ron Selberg and John Carnochan and during 12 sorties, spread over nine weeks that ratchetted up 29 hours of flight time, the system proved to be highly successful and '955, together with the large noise-jammer, was returned to Palmdale by Tom Pugh and John Carnochan on 31 October.

Carried in bay K and weighing in 900lb, DEF H was an extremely powerful piece of kit that provided threat warning and, when required, barrage and deceptive noise-jamming protection against the SAM threat. It included a transceiver, two transmitting systems, an interface unit (IU), a data processor and an evaporative cooler. Radar signals received by a forward centreline antenna were sent to the transceiver. Signals possibly associated with the SA-2 'Guideline' and SA-3 'Goa' (E-band) were received by an aft centreline antenna and routed to the DEF H system through a band pass filter and pre-amplifier.

The IU controlled the jamming pulses generated by the transmitting systems, which were designated as low band or high band. Each band could be driven by commands from the DEF control panel. Upon receipt of signals from DEF C2, DEF H transmitted on frequencies determined by the 'LO' and/or 'HI' band selections on the RSO's DEF console. Signals received by DEF H were processed to determine their polarity (vertical or horizontal), allowing for the most effective jamming response. They could be recorded on the AR-1700 for later analysis.

DEF H received another modification/upgrade which was extensively tested during a deployment to Griffiss AFB made between 13 August and 3 September 1975. During those 21 days away from Palmdale, '955 and its flight test crews made a total of 65 passes during 19 flight hours against the new SAM threat – again these were later applied to Beale's Blackbirds. Other modifications and updates were made to DEF H between 20 September 1978 and 7 February 1979 and again between 13 July and 22 August 1979. Although neither of these involved deploying to utilize the test facilities available at Griffiss or Eglin, the modifications were thoroughly 'put through the wringer' during 14 test sorties.

Whilst '955 was having its fuel tank sealant replaced between September 1979 and July 1980, '974 temporarily became Palmdale's test bird after having first undertaken a three hour-40-minute FCF on 16 May 1980. Of the 32 flights it subsequently made before returning to operational duties on 21 January 1981, 26 were dedicated to further updating DEF H. With the Soviet deployment of the much-improved SA-5 Gammon Surface to Air Missile, it's easy to understand the necessity of ensuring that DEF H was kept abreast of these advances. Once again '955 was testing yet more 'tweaks' to its DEF H noise jammer. Between 31 March and 27 October 1982, a total 18 evaluation flights were flown from Palmdale that directly related to these modifications.



The Ampex Model AR-1700 recorded a wide range of ELINT signals, from locations up to 350 miles from the SR-71's track, onto magnetic tape. It also recorded aircraft maintenance data. (Stewart Bailey via Paul Crickmore)

The Blackbirds were equipped with a Lockheed SR-1 ejection seat, which was air tested from an F-102 Delta Dagger. (Lockheed Martin)

DEF M was a deception repeater jammer using a technique known as range gate pull-off (RGPO) against the SA-5 'Gammon'. DEF M used a single antenna located on the aircraft's underside centreline forward of the RSO's view sight, and was protected by a slightly protruding fibreglass radome. The antenna was time-shared between DEF M's receive and transmit functions. Jamming continued for five seconds after the threat was no longer present. It underwent its first test flight on '955 on 6 November 1984, which was flown by BC Thomas and Bill 'Flaps' Flanagan during which 16 subsonic and one hot pass were made against the test facility – the flight clicked BC's flight hours on the SR-71 into 1,000. The final flight made by the SR-71 relating to DEF M occurred on 16 January 1985. It lasted three hours and 10 minutes and was flown by Tom Tilden and Bill 'Flaps' Flanagan. Two further flights were made by '955 and the same crew after the final one on 28 January 1985. '955 was returned to its 'barn' and retired.

RANGE GATE PULL-OFF OR SIDE-STEP JAMMING

Barrage noise jamming might be considered the ECM equivalent of taking a sledgehammer to crack a nut, while RGPO is the essence of surgical finesse. Basically, when a tracking radar has detected its target, it brackets it with range gates. These essentially blank out all other signals that originate from outside the narrow ‘window’ the gates have created, thereby increasing the signal-to-noise level ratio. The radar then ‘focuses’ on a range interval of just a few hundred metres that frames the target’s location, and no longer attempts to detect other targets. This state of affairs is known as radar lock-on. But range gates can be ‘hijacked’, causing the radar to break lock, and this is precisely what RGPO does.

Firstly, the RGPO jammer determines the incoming radar’s pulse repetition frequency. It then amplifies and re-transmits it when further pulses are received. Highlighting itself on an enemy’s radar screen in this way hardly seems like a good idea, but the jammer progressively increases its power, creating in the process a much stronger return than that generated by the aircraft itself. The sensitivity of the tracking radar’s receiver has to be reduced to avoid overload. As a consequence, the aircraft’s actual return is immersed and vanishes below the ‘noise floor’.

Now this time, the RGPO jammer transmits a second replica after each of the ‘dummy’ echoes. The power of this second replica return is again increased, while the dummy is made weaker. At this point, the tracking radar locks on to the now stronger second replica return, which the RGPO jammer begins to delay by small but ever-increasing amounts of time. The radar’s range gates follow the dummy target, which appears to be receding. This continues until the radar’s range gates have moved away from the target’s true position, thereby causing the radar to track a phantom target.

Now the aircraft’s actual return is blanked out entirely by the range gates and the RGPO jammer switches off, leaving the illuminating radar with nothing but noise between its range gates. The threat radar now has to revert back to search or acquisition mode, while the target has sped away. Countermeasures to RGPO are available, including switching to another PRF, which renders the jammer incapable of anticipating the timing of the next illuminating pulse. There are also other methods, as well as counter-countermeasures to these, but they fall outside the scope of this book.

CREW SURVIVAL SYSTEMS

Air Force regulation 60-16 requires pressure suits to be worn when flying above

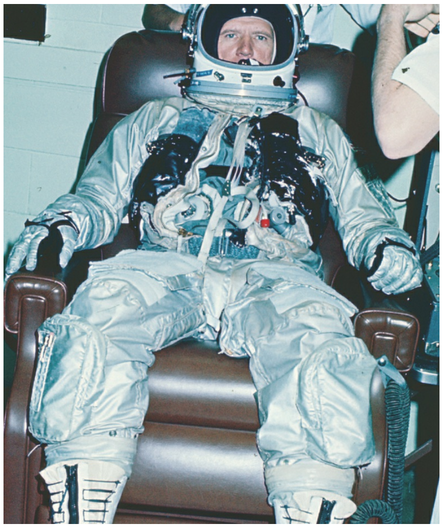
50,000ft, the reason being that entry into this abnormal environment can cause many physiological problems that, if left unchecked, would kill the crew in minutes. For example, during ascent, a reduction in the partial pressure of oxygen will cause hypoxia if unprotected above 25,000ft. Progressive cardio-respiratory and neurological effects trigger such symptoms as euphoria, loss of judgment and impaired memory. If unchecked, semi-consciousness and unconsciousness follows, with death resulting four or five minutes later. Also, above 25,000ft decompression sickness (DCS) develops, due to the reduction of ambient air pressure. It is acquired with increasing rapidity and severity the higher the altitude. The condition results from the evolution of nitrogen gas bubbles from body fluids as the pressure falls (much like the bubbles generated in a carbonated drink bottle when its top is removed). Joint pain (the 'bends'), chest pain, skin-itching and neurological manifestations may develop alone or together, the latter being more serious and potentially fatal.

Gas-containing body cavities – lungs, gut, sinuses, etc. – increase in volume on ascent and contract on descent. Most of these problems are self-righting via the body's orifices; however, gas within the small gut is not free to escape and expansion can cause abdominal pain. To help reduce such symptoms, the crew ate a high protein meal prior to flight. During descent, considerable pain can arise if pressure in the middle ear cavities and sinuses cannot be equalized; for this reason, crews underwent routine medicals prior to flight and should a slight cold or throat infection be detected they would be grounded until the condition had cleared. Were the crew to be subjected to the outside air temperature prevailing at 80,000ft, they would undoubtedly risk local or general cold injury (frostbite and hypothermia, respectively).

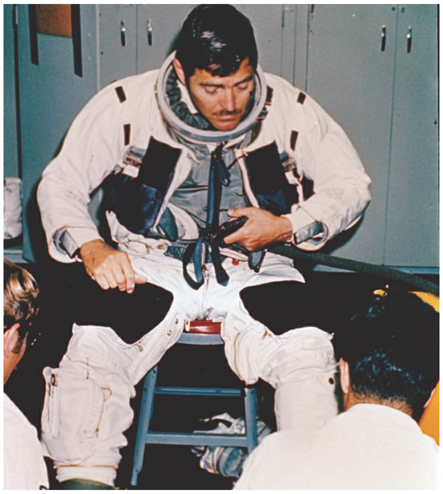
To protect the crew from these effects, the cockpit was pressurized and pressure suits were worn. Within the cockpit, pressurization was allowed to rise from sea level to 8,000ft; it then remained constant to 25,000ft. At these altitudes the ambient air pressure fell from 10.9psi to 5.9psi respectively, giving rise to a pressure differential of 5psi. This maximum figure was maintained by the aircraft's pressurization system throughout the flight profile, ensuring that the fuselage was not subjected to unduly high-pressure gradients, which in turn meant that construction weight could be reduced. However, in the event of rapid decompression or ejection, it meant that the crew had to wear full pressure suits to survive.

Like most other systems associated with the SR-71, the pressure suit too evolved throughout the life of the programme. The first suit was ordered and custom-made by the David Clark Company in Worcester, Massachusetts on 7 March 1960. Designated S-901, it was made for Capt Harry Collins, who thoroughly tested the suit in numerous decompression checks. The second suit for Subject Number Two was ordered on 28 June 1962, was designated S-901A and made for Lou Schalk – the Lockheed A-12 Chief Test Pilot. Thereafter, the suits were developed in parallel with the Oxcart programme, each being tailor-made for its owner and sequentially designated S-901A to S-901H. A culmination of re-design work and development created the S-970 suit, which again was bespoke for its owner and used by both Agency Oxcart pilots and Air Force YF-12 crewmembers.

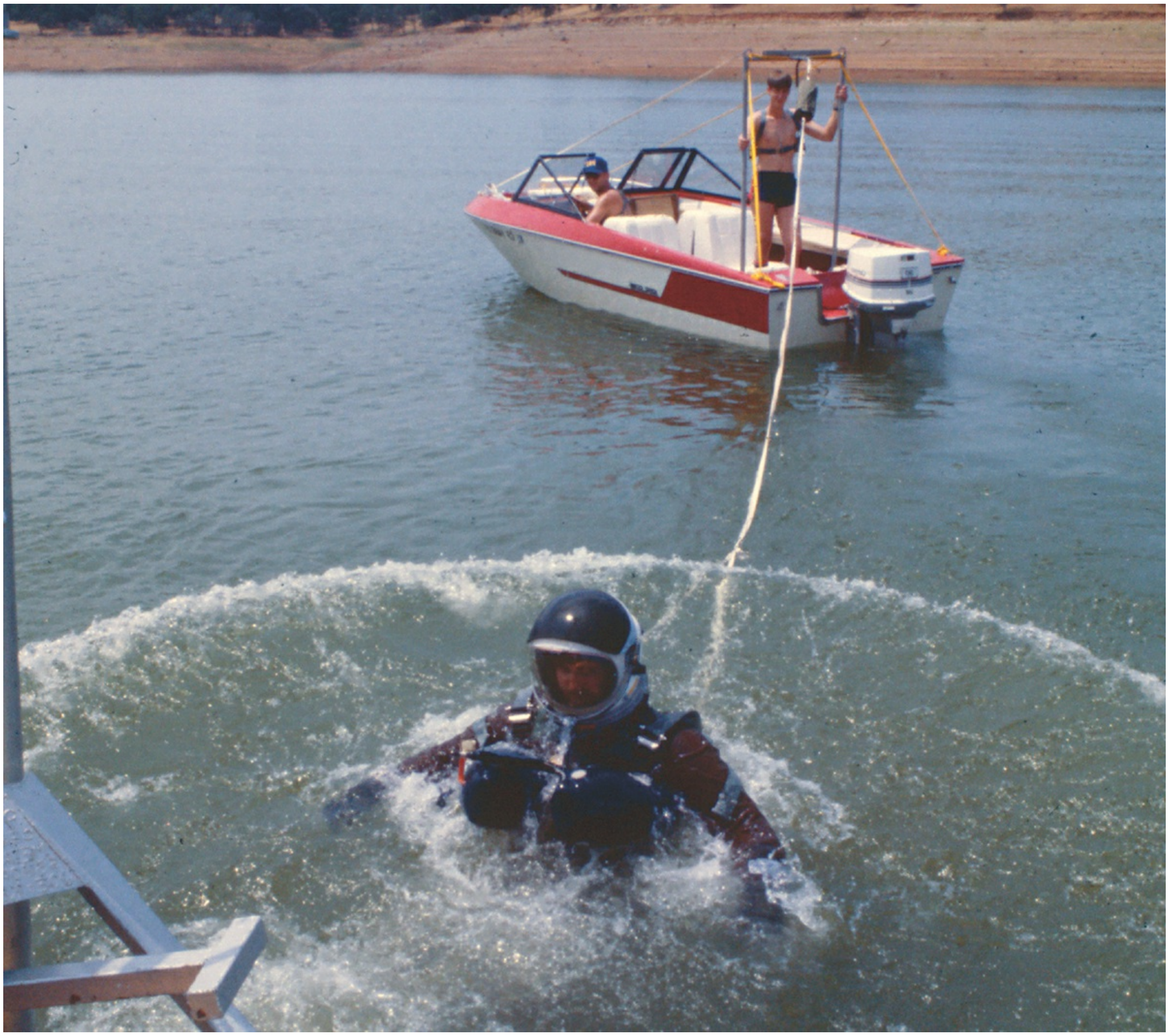
The first suits designed for the SR-71 programme were designated the S-901J. These varied from their forebears, as they were non-custom-built and instead were available in 12 standard sizes, the first of which were produced in 1965. Initially, the outer coveralls of these early suits had a layer of aluminium vacuum deposited on HT-1 material to provide a level of fire-resistant protection during high-Mach ejection and to help reflect heat away from the crewmember when in the cockpit since the inner surfaces of the windows routinely reached temperatures of 120°C. The problem was that the suit also generated unwanted reflections, making it difficult for the crew to monitor instruments. A white coverall was developed that reduced, but didn’t eliminate the problem. The drawback here was that the white Dacron material from which they were made wasn’t fireproof; so David Clark developed a material they called Fypro. Their dark chocolate brown colour killed unwanted cockpit reflections, but did nothing to reflect internal cockpit heat away from the crew. In 1977 the company had developed the next generation of pressure suits, designated the S-1030 series; these featured a high level of commonality between both the U-2 and SR-71 programmes. Coloured ‘Old Gold’ and designated S-1031C for SR-71 usage, they incorporated state-of-the-art textiles and were more durable and comfortable. The suit’s four layers consisted of an outer coverall of Dacron (a form of terylene) that was durable, tear and fire resistant. A restraint/joint layer held the suit together through restraint lines and acted as a pressure boundary; a third ‘bladder’ layer performed rather like a tyre inner tube and was made of polyurethane; finally an inner scuff layer protected the all-important bladder layer from scuffing against other clothing and the urine collection device (UCD). An optional thermal layer could be worn inside the suit, but this was usually discarded in favour of more comfortable long cotton underwear, which was worn inside-out to prevent its seams from pressing into the skin.



Blackbird crew wore full pressure suits made by the David Clark Company. The suits worn by A-12, YF-12, M-21 and early SR-71 crewmembers were designated S-901 and their outer coveralls were silver in colour. (USAF)



The next derivation had white coveralls, which reduced cockpit reflections and were made from flame-resistant Nomex. (USAF)



The dark-brown-coloured suits made from Fypro eradicated unwanted cockpit reflections but didn’t reflect cockpit heat away from the suit. (USAF)

MAJOR
TOM DANIELSON

The final version of the suit used during the Senior Crown programme was the David Clark S-1030 series. (Paul F. Crickmore)

Again the suit was built in 12 sizes and assumed the seated position when pressurized in order to aid cockpit mobility. Gloves completed the pressure seal and were attached via wrist hinges. Boots featured heel retraction straps or ‘spurs’ that were connected by cable to the ejection seat on entry to the cockpit. The complete pressure suit system cost about $30,000 a copy and lasted 10–12 years, undergoing a complete strip-down overhaul every five years and a thorough inspection every 90 days or 150 hours.

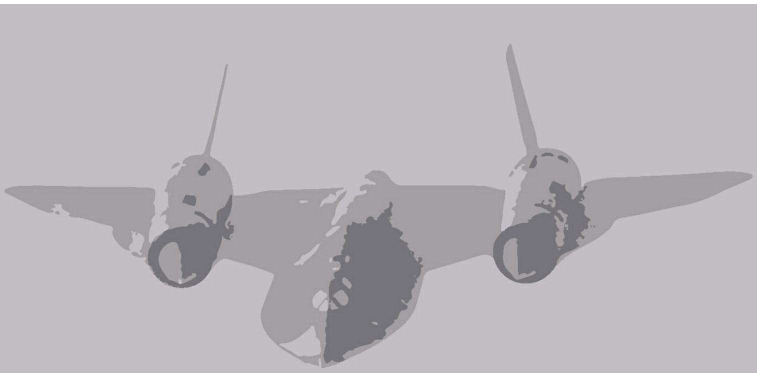
ESCAPE SYSTEM

Both crew positions were equipped with electrically adjustable ejection seats that were activated in an emergency by using the ‘D’ ring located at the front of the seat. The rocket-powered seats automatically extended knee kickers, feet retractors and locked the shoulder harness. The minimum safe altitude to use the seat in the early days was ground level, provided that the aircraft was travelling faster than 65kt. This automatic system was designed for extreme altitude bailouts, its two-stage ’chute system consisted of a 78in. stabilizing ‘chute that deployed immediately following separation from the seat, provided that the altitude was greater than 17,000ft. At 16,800ft the stabilizing ’chute was jettisoned by a timer-actuated mechanical release. During this second stage, the main 35ft ’chute opened at 15,000ft. If bail out occurred below 16,200ft, the stabilizing ’chute sequence was bypassed and the main deployed at 15,000ft. Oxygen for both breathing and inflation of the pressure suit was provided from six 20 cubic inch bottles, located in the back of the parachute pack and provided enough oxygen for 30 minutes.

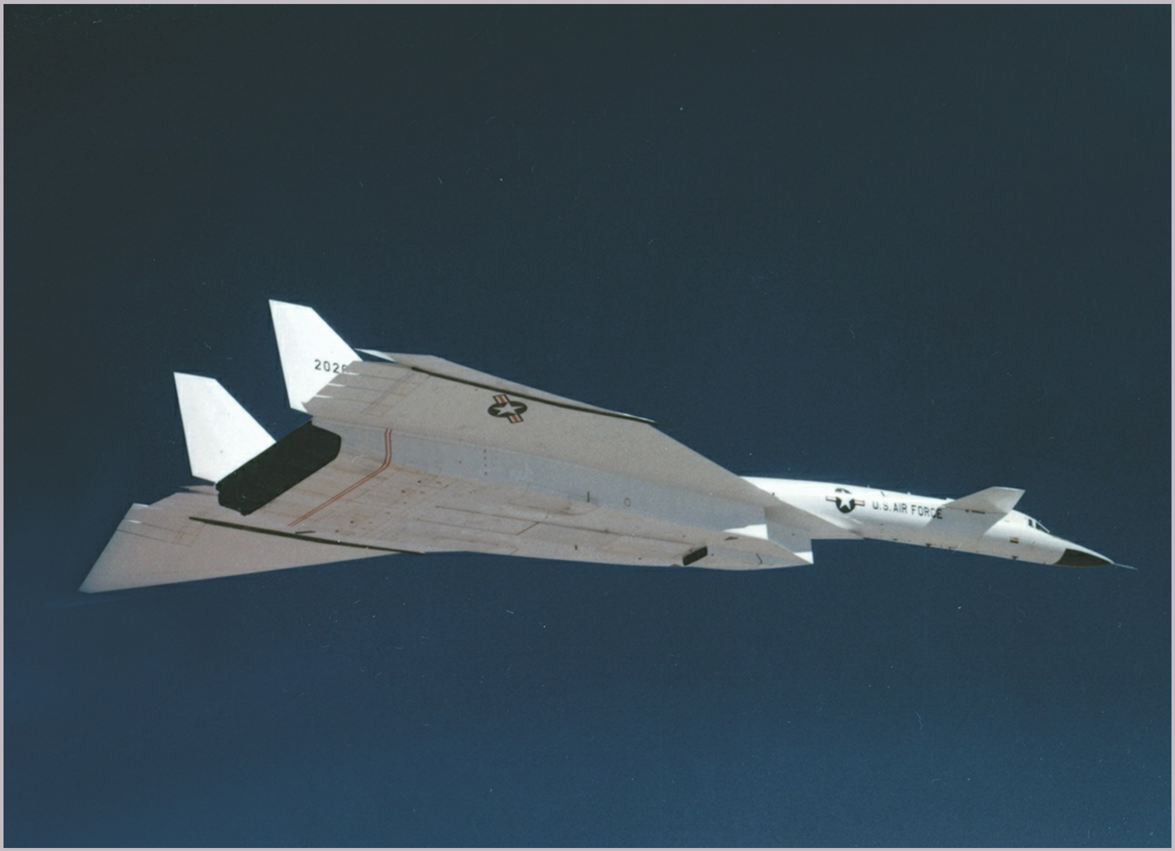
The oxygen system in the aircraft consisted of four 875 cubic inch bottles, two for each crew position and provided sufficient oxygen to last for 7.9 hours. Should this system fail, a back-up source was available utilizing that in the parachute emergency system, simply by pulling a round green toggle – referred to as the ‘green apple’. The crew’s pressure suit was ventilated by the aircraft’s air conditioning system and the temperature regulated by an electrical heating element, controlled by the pilot.

DRAG ’CHUTE SYSTEM

To aid braking after touchdown, a 40ft ring sail ribbon ’chute was located in a compartment on the top aft section of the fuselage. This could be deployed at a maximum speed of 185kt when the ’chute deployment switch in the cockpit was thrown. This action opened the two ’chute compartment doors, the left door pulling out the ripcord pin during the opening process. A spring-loaded 18ft pilot ’chute then deployed pulling out a 10ft parasail, which in turn pulled out the main drag ’chute. The parasail broke away from the main when the brake force exceeded 80lb. The brake ’chute could then be jettisoned by the pilot moving the ’chute switch to the jettison position, an action necessary before the aircraft had slowed below 20kt, to ensure that the heavy ’chute attachment ball was pulled clear of the rear fuselage to avoid possible damage.



CHAPTER 10:
FROM RS TO SR AND BEYOND



To replace its B-52s, the USAF planned to operate a fleet of North American Aviation B-70 nuclear-armed, deep-penetration supersonic, strategic bombers. However, when John F. Kennedy came to office, he cancelled the project on 28 March 1961 calling it 'unnecessary and economically unjustifiable'. (USAF via TD Barnes)

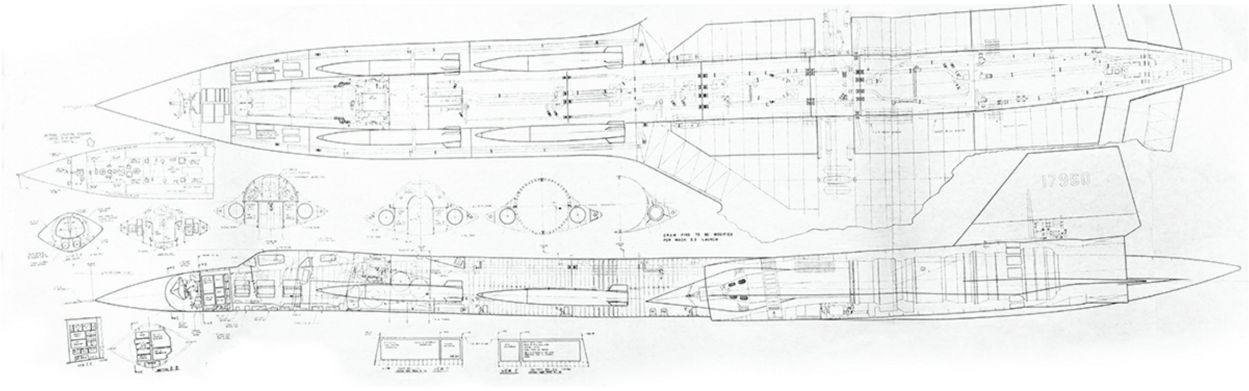
During the initial stages of assembling the YF-12A, it became apparent to Skunk Works engineers that the basic interceptor airframe could be adapted to produce a strike bomber. Rus Daniell approached Kelly with the idea and was asked to write a basic feasibility report. Having reviewed Daniell's document, Kelly Johnson began work on the idea that he referred to as the RB-12 (RB for 'Reconnaissance Bomber'), on 14 September 1960.

In January 1961, he took his unsolicited proposal to Washington and dropped it on the desk of Under Secretary of the Air Force, Dr Joseph Charyk. Charyk then summoned Col Horace Templeton from the Air Development Center at Wright Field, Ohio to Washington and asked him to complete an engineering analysis of the proposal. Lacking the required detailed knowledge of integrated bomber systems, Templeton recruited into his team Maj Ken Hurley.

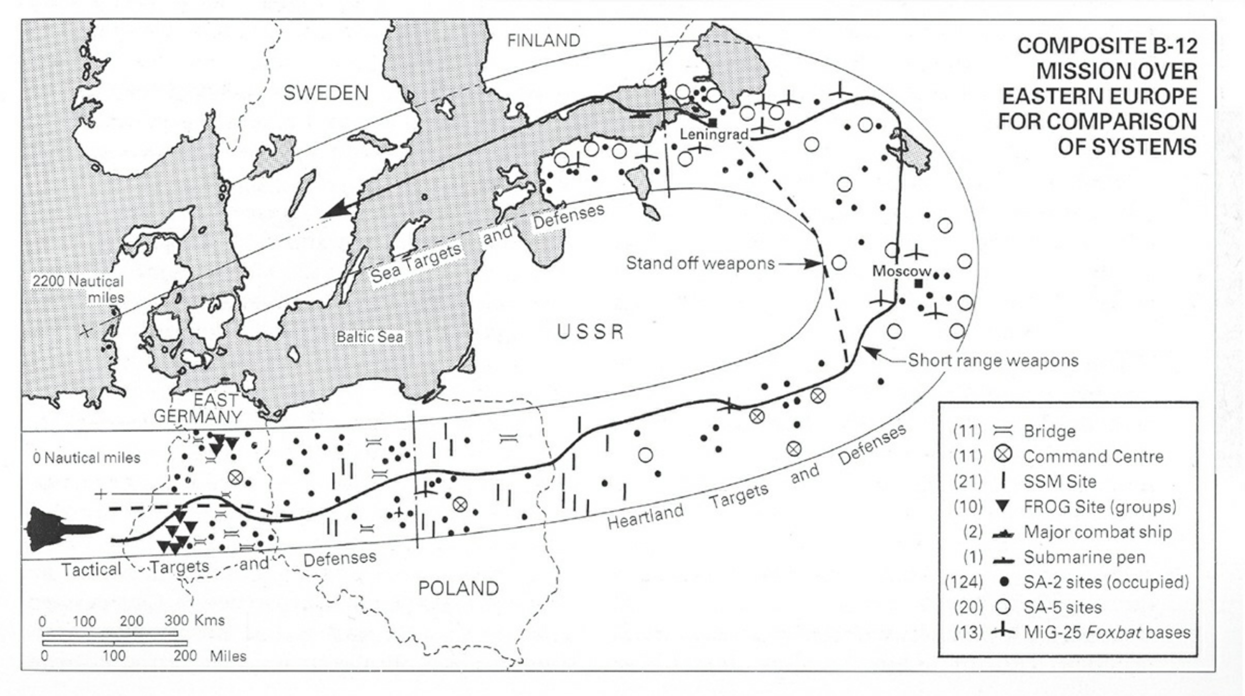
This proved to be an extremely insightful move, but it placed Hurley in a tricky position as he was instructed to continue with his important 'white world' Air Force work on stand-off weapons for the North American RS-70 reconnaissance-strike bomber (later rechristened B-70) while also working on the 'black world' Lockheed proposal. To further complicate matters, he was to report in parallel to his boss at the Pentagon, Col David Jones and Col Templeton, while under the strictest orders not to inform Jones about his 'other job', since Jones was not cleared into the programme.

Just ten weeks later, Templeton's team took its refined proposal, which it referred to as the RS-12, back to Charyk. He liked what he saw and instructed them to present it to the Skunk Works boss at Burbank. To his enormous credit, Johnson too was extremely impressed with how the team had enhanced the capability of his original design, and as a result shelved his RB-12 proposal in favour of the team's RS-12 design.

Pentagon staffing of the initiative became the province of the Chief of Special Activities, Col Leo Geary, and Lew Meyer, a Special Projects finance officer. The Air Force selected two competing teams (Westinghouse and Goodyear) to provide radar and weapons system integration, requiring them to work in isolation. It was proposed that each RS-12 would carry a single nuclear weapon internally. It would be based on the Hughes GAR-9/AIM-47 missile (as carried by the YF-12A) and equipped with an adaptation of the Polaris A-3 1Mt warhead.



Engineering drawing of the B-71. (Lockheed Martin)


COMPOSITE B-12 MISSION OVER EASTERN EUROPE FOR COMPARISON OF SYSTEMS
FINLAND
SWEDEN
Leningrad
Sea Targets and Defenses
2200 Nautical miles
Stand off weapons
Moscow
Baltic Sea
USSR
Short range weapons
EAST GERMANY
0 Nautical miles
Heartland Targets and Defenses
Tactical Targets and Defenses
POLAND
0 100 200 300 Kms
0 100 200 Miles
(11) ⌶ Bridge
(11) ⊗ Command Centre
(21) I SSM Site
(10) ▼ FROG Site (groups)
(2) Major combat ship
(1) Submarine pen
(124) ● SA-2 sites (occupied)
(20) ○ SA-5 sites
(13) MiG-25 Foxbat bases

Composite B-12 Mission over eastern Europe for comparison of systems. (Osprey)

Under SAC's SIOP, to be implemented in the event of a nuclear war, the RS-12's concept of operations would require the aircraft to penetrate enemy airspace at Mach 3.2 and 80,000ft, use its radar to search designated areas, then locate, identify and strike selected targets. Using the GAM-87 ANS that had been developed for the subsequently cancelled Skybolt ballistic missile, the Air Force and Skunk Works teams confidently predicted that an RS-12 with an all-weather, radar-guided missile would be capable of hitting its target within a

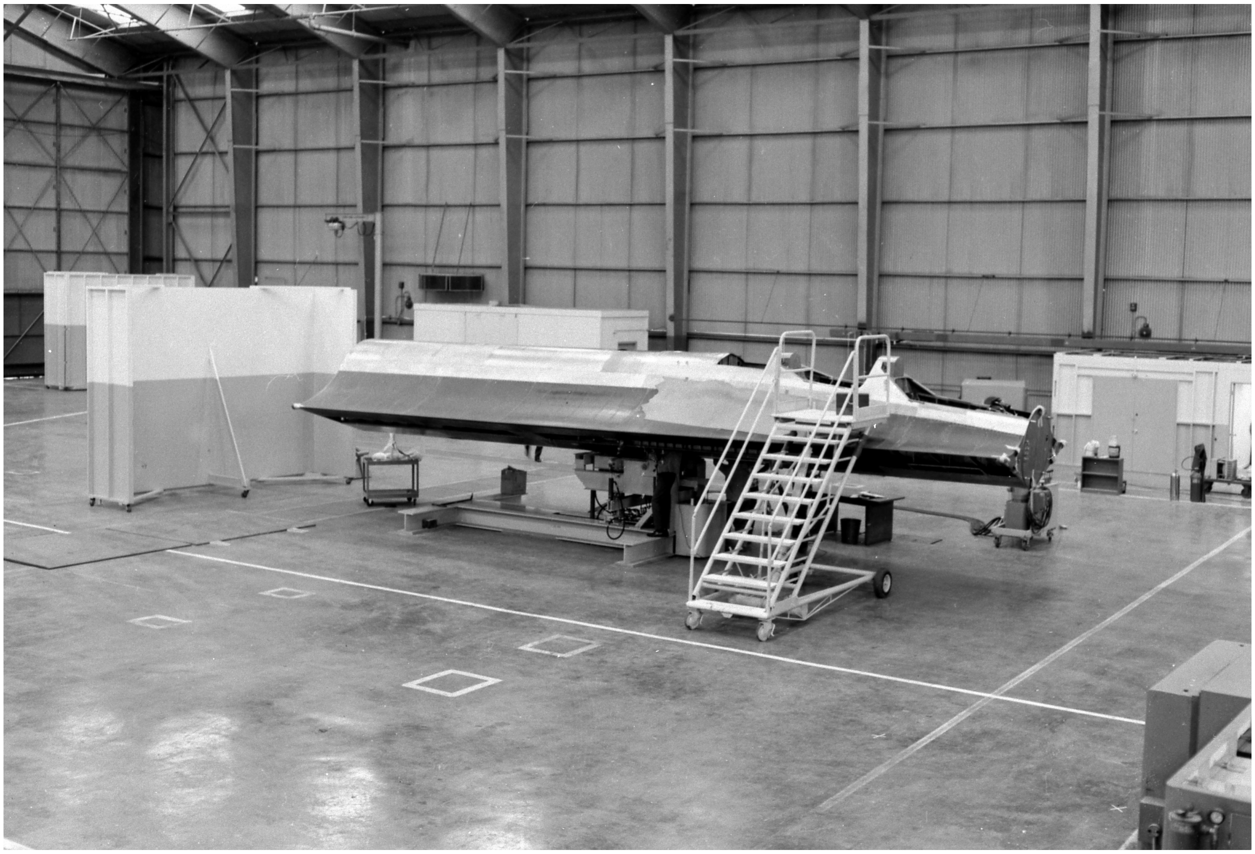
50ft CEP and just 20ft CEP using an optical system to guide a missile launched from 80,000ft and distance of 50 miles.

There remained, however, significant doubters. Secretary of Defence Harold Brown rather pompously proclaimed that the entire proposition was ridiculous and that 'finding a target along a 3,000-mile track in a swathe 20 miles wide was like quickly locating a single word in the *Encyclopaedia Britannica*.' Viewed in such simplistic terms, target-finding and pin-point strike accuracy was certainly an ambitious undertaking, but the proposed RS-12 was intended to look for en route cues that would lead it directly to its specific targets.

Even Kelly was sceptical. Rus Daniell recalled a conversation with his Skunk Works boss during a return flight from Washington to Burbank in the company JetStar. 'Kelly turned and asked, "Do you still think you can hit that garage door down there, Rus?"' Daniel replied in the affirmative, adding, 'What you don't do is aim, shoot and forget. Like your car, you don't point it at your garage from the parking lot at work, close your eyes and drive.'

On 14 May 1962, Charyk flew to Burbank to review progress to date. On arrival he was directed to the RS-12 mock-up, into which a prepared mission tape had been installed for a demonstration. The tape contained experimental side-looking airborne radar (SLAR) imagery taken from a B-58 Hustler as it flew 1,200 miles at Mach 2 over six western states. The radar map had been transposed onto a 35mm film and was moved through the back-seater's radar display at a speed that equated to Mach 3.

Charyk was briefed on how to work the cursor that would be placed over a target and then 'pickled' to feed information into the weapons system. He was then invited to 'fly' a mission and see at first-hand how, in the words of Secretary of Defence Brown, 'a single word in the *Encyclopaedia Britannica*' could be located when you knew how the system worked. He emerged from the cockpit 40 minutes later beaming – he had located and 'pickled' all 20 designated targets. The feasibility argument had been laid to rest.



The full-scale engineering mock-up of the SR-71A forebody. (Lockheed Martin via Tony Landis)

WARNING
THIS AIRCRAFT CONTAINS A SEAT
CONTAINING AN EXPLOSIVE CHARGE.
SEE MAINTENANCE MANUAL BEFORE
REMOVING
RESCUE
CANOPY JETTISON
1.PUSH BUTTON TO OPEN D
2.PULL "T" HANDLE OUT

Dutch 51, Bob Gilliland was Lockheed's chief SR-71 test pilot. He is seen here in an early S-901 pressure suit. (Lockheed Martin)

On 4 June 1962, Rus Daniell, Col Templeton and a number of other Air Force 'recon people' reviewed a 90-day RS-12 study granted to the Skunk Works by the Air Force, as well as the RS-12's forward forebody Class 1 mock-up. Although this was concluded satisfactorily, a firm commitment to move ahead with hardware was not forthcoming. The problem was that the ballistic missile had come of age and considerable doubt was being expressed in some quarters about the long-term viability of bombers as a delivery platform for nuclear weapons.

SAC had retired more than 1,500 B-47s from the inventory and President John F. Kennedy had cancelled the proposed high-profile, multi-million-dollar B-70 Valkyrie bomber on 28 March 1961. (Only two prototypes of this large bomber were built for research and development purposes, and based at Edwards AFB from 1964 to 1969. An XB-70 was lost following a mid-air collision in 1966.) The upshot was that the RS-12 was never funded and came to nothing.

Undaunted, this didn't stop Johnson from submitting other unsolicited bomber proposals to the Air Force. One such, referred to in-house as the B-71, was made to a small contingent of Air Force generals in April 1965. Another made to representatives from the Defense Advanced Research Projects Agency (DARPA) on 23 October 1973 envisaged a modified SR-71 harnessing greatly increased levels of kinetic and potential energy to deliver inert weapons. Such weapons obviated the need for warheads, thus reducing the cost of the missiles appreciably. For example, a weapon weighing 1,200lb launched at Mach 3.2 and 80,000ft on an optimum –0.5g trajectory had the ability to penetrate 23ft of reinforced concrete. This high-velocity projectile would cause virtually no collateral damage, but considerable damage to a subterranean target (like a bunker or missile silo) as the weapon's kinetic energy transferred to, and throughout, the structure. The same weapon could penetrate hard soil to a depth of about 120ft. If combined with a small high-explosive or nuclear warhead, it becomes a highly effective sub-surface weapon, as the explosion causes soil above to collapse, and thus contain fallout in a nuclear scenario. Despite the concept's feasibility and moderate cost, however, they all remained 'paper only aircraft'.

U.S. AIR FORCE
17950

Article 2001, serial 61-7950, from a chase F-104 during the prototype's first flight. (Lockheed Martin)

R-12 THE UNIVERSAL AIRPLANE

On 6 December 1962, Kelly Johnson noted in his log: ‘Working on R-12 *Universal* airplane, using company work order. Can get no decision on any military version of the aircraft, but there does seem to be considerable interest in it.’ Johnson’s rationale for this design was based on the premise that if he produced a single platform capable of performing the reconnaissance, recon/strike or intercept roles depending on customer needs, it would greatly simplify production, and ‘it eliminates the necessity of the Air Force deciding which version they want to buy.’

Seven days later the Skunk Works was visited by several SAC personnel, and Johnson logged that ‘they wanted to see what kind of a reconnaissance version would meet SAC’s needs… We prepared our proposal for a 140,000lb reconnaissance airplane capable of carrying 4,300lb of reconnaissance gear and gave it to Col Templeton with a forwarding letter.’

On 20 December, Kelly noted that he and several of his engineers flew to Washington to continue their contract pursuit. ‘Presented our R-12 version, which Templeton and group presented to the Air Force in a closed session the next day. The outcome was that we were proposing too heavy an aircraft, with too much equipment, so we were requested to scale it down to 1,500lb of payload.’

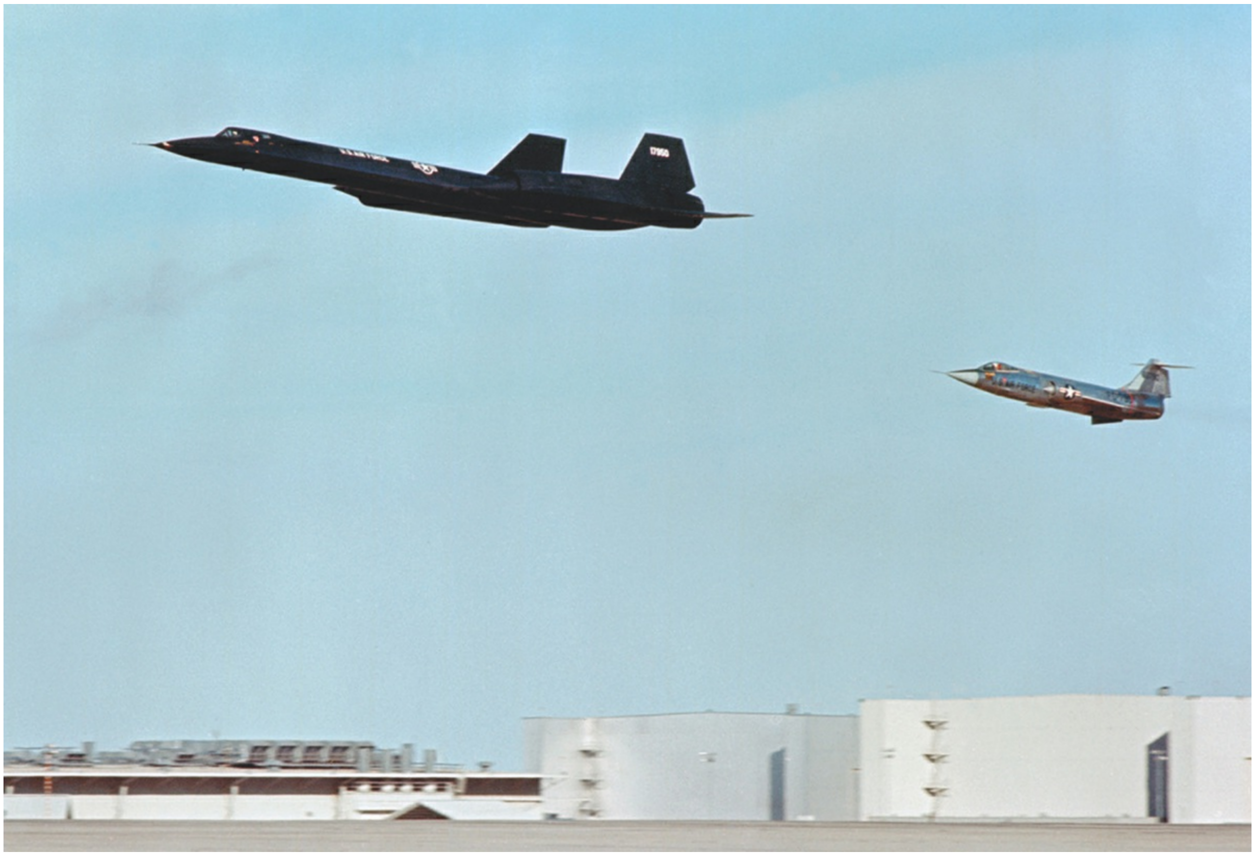
Further design refinements of the R-12, primarily under Rus Daniell, continued, and were finally rewarded on 18 February 1963, when Lockheed was awarded pre-contractual authority to build six R-12s, on the understanding that an additional 25 would be ordered by 1 July.

A classified memo dated 15 February 1963 to John McCone (DCI) from Dr Charyk, now Director of the National Reconnaissance Office, noted how the new reconnaissance programme would be funded:

> We have recently had approval by the Secretary of Defence for a 138,000lb, two-place reconnaissance version of the basic A-12 design, to be known as the R-12.
>
> Your organization in three previous instances, the U-2, the A-12 and the AF-12 [the long-range interceptor version], has acted as a procurement agent for the Air Force. Inasmuch as the decision has already been made that the R-12 programme will be administered in the black, it is requested that you again perform as the procurement agent for the R-12. A memorandum of understanding similar to that existing for the AF-12 programme is being drawn up and will be reviewed with the appropriate personnel in Dr Scoville’s office in the immediate future.

The first mock-up review of the new reconnaissance aircraft took place on 13/14 June 1963, and Johnson noted, 'I think the Air Force are well impressed with our operation to this point.' Another mock-up conference took place on 11 December, and was again deemed a success by Johnson. By 18 March 1964 construction was moving ahead rapidly, but contract negotiations with the Air Force had yet to be concluded.

Johnson noted in his log: 'Spent several days … on … the first six R-12s. It is extremely difficult to get a reasonable profit for what we do and no credit is given for the fact we operate more cheaply than the others.' Eventually agreement was reached, and with an aircraft production rate set at one aircraft per month for 31 months, the programme was completed under budget at a cost of $146 million (approximately $1.5 billion at today's values). This excluded engines and sensors, but included Categories I, II and III of the flight test programme – a remarkable achievement by any standards.



With Lockheed test pilot Jim Eastham flying the F-104 chase-plane, Bob Gilliland completed '950's first flight on 22 December 1964 with a low pass over Palmdale. (Lockheed Martin)

On 29 February 1964, during the run-up to that year's presidential election campaign, and in response to a challenge by Republican candidate Senator Barry Goldwater that the Democrats had neglected the defensive needs of the country, incumbent President Lyndon B. Johnson revealed the existence of the 'A-11' [A-12] programme. Five months later, on 25 July, in yet another piece of electioneering, Johnson made a second announcement about another hitherto black world aviation programme:

> I would like to announce the successful development of a major new strategic manned aircraft system which will be employed by the Strategic Air Command. This system employs the new SR-71 aircraft and provides a long-range advanced strategic reconnaissance plane for military use, capable of worldwide reconnaissance for military operations. The Joint Chiefs of Staff, when reviewing the RS-70, emphasized the importance of the strategic reconnaissance mission. The SR-71 aircraft reconnaissance system is the most advanced in the world. The aircraft will fly at more than three times the speed of sound. It will operate at altitudes in excess of 80,000ft. It will use the most advanced observation equipment of all kinds in the world. The aircraft will provide the strategic forces of the United States with an outstanding long-range reconnaissance capability. The systems will be used during periods of military hostilities and in other situations in which the United States' military forces may be confronting foreign military forces.
>
> The SR-71 uses the same J58 engines as on the experimental interceptor previously announced, but it is substantially heavier and it has a longer range. The considerably heavier gross weight permits it to accommodate the multiple reconnaissance sensors needed by the Strategic Air Command to accomplish their strategic reconnaissance mission in a military environment.
>
> The billion-dollar programme was initiated in February of 1963. The first operational aircraft will begin flight-testing in early 1965. Deployment of production units to the Strategic Air Command will begin shortly thereafter.
>
> Appropriate members of Congress have been kept fully informed on the nature of and the progress in this aircraft program. Further information on this major advanced aircraft system will be released from time to time at the appropriate military secret classification levels.

The announcement was a calculated political risk, as the aircraft had yet to undertake its maiden flight. It is also the first known instance of the Air Force's designation 'SR-71' being used. Research has been unable to establish exactly when the aircraft's role designator was changed for 'strategic reconnaissance', or who was responsible for the change.

For many years it was believed that when President Johnson made his 25 July announcement, he made a mistake and should have said RS-71. This is now proven incorrect, however. Audio tapes of Johnson's speech record that in all three places where the president said 'SR-71', his text stated 'SR-71'. However, the stenographer's copy of the speech, which was circulated to the world's press, transposed SR-71 into RS-71, thus giving rise to the 'error legend'.

FIRST FLIGHT PREPARATIONS

In August 1964, Kelly phoned Bob Murphy and asked him if he wanted to work on the SR-71 programme. At the time, Murphy was a superintendent in charge of D-21 drone production. Drone number one was undergoing final checkout, while another nine were at various stages of assembly. Bob accepted the offer and was immediately briefed by Kelly, who said, 'I want you to go to Palmdale and get Site 2 away from Rockwell. Hire the people you need. The pieces of the SR-71 will be up to you on November 1st and I want her flying before Christmas. Oh, I also want you to move up there because I don't want you to commute.' This was typical of the way Kelly operated. The next day, Murphy went out to Palmdale and met the base commander, who arranged a meeting between the various parties affected by their activities. Murph recalled:

> Rockwell controlled all three sites; they were using Site 1 and Site 3 for B-70 production. Site 2 housed various other facilities, including a paint shop and a huge telephone exchange. The meeting got under way and I began negotiating for various parts of the building that would have to be vacated by specified dates to allow our people to move in. One of the Rockwell people said, 'Well we don't have anything from the Air Force that says we need to be out of this building.' At that point I bluffed a move to get out of my chair and said, 'You don't?' Well I'd better call Washington and find out what the heck is going on.' The ruse worked and he said, 'Wait a minute, we don't have to get Washington involved in this,' and I was able to complete the arrangements without having any official orders to do so – although they were probably just around the corner.

So it was that Lockheed inherited Site 2 (Air Force Plant 42, Building 210) at Palmdale, California. The prototype SR-71A (Article 2001, 64-17950) was delivered in disassembled form in two large trailers on 29 October 1964. At that point Bob Murphy's team 'went into overdrive' in an attempt to fulfil the extremely tight deadline set by Kelly.

In the summer of 1964, Kelly had offered test pilot Robert J. Gilliland the post of chief project pilot for the SR-71. It was a position that Bob was admirably qualified for, having gained a great deal of experience as a member of the F-104 and A-12 test teams. In early December, Kelly and Bob flew from Burbank to Palmdale in Lockheed's corporate JetStar to review the progress toward final assembly. Murph escorted them around Building 210, revealing in the process that Article 2001 was spread all over the hangar floor.

During the return flight to Burbank, Bob (who was mindful that a number of Air Force generals from Omaha, Wright-Patterson and Washington were planning to be on hand at the 21 December maiden flight) told Kelly, 'Maybe we'd better postpone this thing 'til after Christmas? It's likely to be a little embarrassing to you, me and the Skunk Works if we get them out here and don't go.' Kelly refused to budge, contending that if he postponed schedules every time he was asked, the aeroplane would still be in the jigs.

'950 comes home to roost at Palmdale having completed an early test flight – note the white band around nose. (Lockheed Martin)

U.S. AIR FORCE
17950
USAF

'950 is pictured later in the test programme – minus the white nose band. It, together with '951 and '952, was allocated to the manufacturer's flight test programme. (Lockheed Martin)

Dick Miller led the flight test engineering effort for the entire contractor test programme. Once his brief had been decided upon and approved, he became responsible for the implementation of specific tests to be completed on individual flights. During those final weeks leading up to the first flight, Bob Gilliland recalled having to attend frequent meetings that he characterized as being 'tedious and in great danger of causing analysis-paralysis'. There was considerable discussion as to whether the first flight should be flown at subsonic speeds with the gear down, or whether the gear should be retracted and (if all went well) the aircraft should be flown supersonically. It was agreed that no dead-stick (power-off) landing would be attempted if there was a serious problem on the first flight and that the aircraft would not be landed on its belly if the gear failed to extend. Ejection was the preferred option in either case. Kelly and Bob agreed that an attempt would be made to fully exercise Article 2001 on its first flight.

With its two J58s installed, '950 conducted its first engine run on 18

December 1964. Three days later, a ‘non-flight’ was conducted. All pre-flight checks were carried out as if the flight was really going to leave the ground. This checkout included firing up both engines; checking control movements; a close scrutiny of gauges, lights, switches and indicators; and external checks for hydraulic leaks or other abnormalities. Finally, after testing trim movement, centre of gravity and radio operations, Bob taxied out to use the brakes and nose gear steering.

He did full engine run-ups at the end of the runway and took the number one position for take-off as if he was going to launch. ’950 was lined up for take-off, and Bob eased the throttles to full military power, checked engines ‘in the green’ and released the brakes. As the aircraft lurched forward, Bob engaged ‘min burner’ to feel the asymmetric ‘pulse-pulse’ of light up. The aircraft accelerated rapidly thanks to its light fuel load, and Gilliland snapped the throttles back to idle upon reaching 120kt. As he deployed the 40ft drag ’chute, the deceleration threw him almost as hard against the shoulder straps as a carrier landing. He jettisoned the ’chute at 50kt, turned off the runway and taxied back to the hangar. There were very few write-ups and the team knew that the aircraft was ready for its maiden flight.

On 22 December 1964, Gilliland (using his personal callsign ‘Dutch 51’) got airborne from runway 25 at Palmdale in the first SR-71. The back seat remained empty for safety reasons and many of the functions that would have been carried out by an RSO or a Lockheed systems engineer were ‘jury-rigged’ onto a special instrument control panel mounted in the pilot’s cockpit.

After take-off, Bob immediately retracted the landing gear, reduced afterburners to ‘min’, turned right and continued his climb northbound over the Edwards test range until he levelled off at 20,000ft and 0.9 Mach. Lockheed’s experienced A-12 test pilot (later to become the second pilot to fly the SR-71), James Eastham flew one of three F-104s that chased ’950 to observe and assist if problems occurred. Two other Starfighters were flown by USAF test pilots Col Robert ‘Fox’ Stephens and Lt Col Walt Daniels. One of the jets was a two-seater and carried a photographer in the rear.

Immediately after Bob’s take-off, Eastham tucked in to close formation on ’950’s right wing, allowing the two pilots to compare and calibrate the SR-71’s airspeed and altitude readings against the F-104’s, to verify accurate pitot-static system operations. The test flight instructions called for manoeuvrability and handling checks during ‘static and dynamic’ stability and control tests. These checks were carried out with the SAS axes 'on' and 'off', both 'individually' and then 'collectively'. Performance comparisons of predicted values of speed versus thrust and fuel consumption were also recorded, followed by a climb to 30,000ft, where cabin pressure, oxygen flow and temperature control were checked.

After passing Mojave, Bob turned left to fly on a heading west of NAS China Lake and then northward up the Owens Valley between the Sierra Nevada Mountains to the west and the White Mountains to the east (all within the Edwards SRA). Just north of Bishop (near Mammoth and Yosemite National Parks), Bob completed a 180° turn to the left and rolled out on a southerly track over the spectacular high cordillera of the snow-covered Sierra Nevadas.

It was now time for a supersonic dash, since all systems were performing well. Just northwest of Bishop, and with Jim's F-104 sticking to the SR-71 like glue, Bob eased the throttles into 'min' burner, checked the engine parameters, and slid the throttle levers up to 'max'. The light test jet accelerated very quickly to 400kt in level flight and on to supersonic speeds quite easily. At Mach 1.2 the master caution warning light flashed on, drawing Bob's attention to the annunciator panel where he saw a 'read-out' light identifying the problem as 'CANOPY UNSAFE'.

Visually checking the two canopy locking hooks on either side of the canopy, Bob verified that the canopy was really 'fully locked'. The pressure-sensitive micro-switches that transmitted the electrical 'unsafe' signal had been activated because an aerodynamic low-pressure area above the aircraft had sucked the canopy up against the locking hooks. It had risen high enough to complete the electrical circuit that turned on the annunciator and master caution lights. Bob correctly analysed the situation as 'safe' and pressed on with the test flight. He advanced the throttles once again and continued to climb and accelerate while rigorously scanning his instruments. On reaching 50,000ft and Mach 1.5, Bob eased the power out of burner into 'mil' and began deceleration to 350kt indicated airspeed, whereafter he descended to 20,000ft to allow the engines to cool.

As Bob approached Palmdale, he was advised by Test Ops that Kelly had requested a subsonic flyby down the runway. He and the accompanying F-104s streaked by to highlight the successful completion of the first flight. At the far end of the runway, Bob chandelled '950 up onto the downwind leg, where he dumped the gear and was most pleased to see the 'three little bright green lights' that indicated all three of the landing gear struts were down and locked. He turned onto a wide base leg and set up a long final approach at 185kt. After making a smooth touchdown on Palmdale's runway 25, he gently lowered the nose and deployed the drag 'chute. At 50kt Bob jettisoned the 'chute, turned off the active runway and taxied back towards the crowd of USAF dignitaries and Lockheed engineers and technicians who awaited his debriefing.

After congratulations from Kelly and the others, the debriefing took place with more than two dozen engineers and subcontractor representatives present. Bob narrated details of his flight chronologically from start-up to shutdown, after which Dick Miller's Lockheed engineers and the other companies' technicians asked clarifying questions. Since the session was recorded, Bob's description was prepared in a typescript that was circulated to all concerned. After this 'first quick look' was satisfied, a further analysis was made of canopy-mounted camera recordings that had viewed the instrument panel throughout the flight. All of this data, along with other 'automatic observation' enabled a Data Reduction Group under Bob Klinger to 'reconstruct' the flight for engineering analysis; so ended Bob's historic 'pre-Christmas' and most successful maiden flight of the SR-71.

Following the first three experimental test sorties, Dick Miller flew as flight test engineer on all the development flights except the limited structural tests, which were pilot-only for safety reasons. Aeroplane numbers '951 and '952 were added to the test fleet for contractor development of payload systems and techniques. With the Phase I Experimental trials complete, the Phase II Developmental test programme began and four other Lockheed test pilots were brought into the project: Jim Eastham, Bill Weaver, Art Peterson and Darrell Greenamyer.

Lockheed's concentrated developmental test efforts were matched by those of HQ Air Force Systems Command (AFSC) at Wright Patterson, where Col Ben Bellis had been appointed System Project Officer (SPO) for the SR-71. His task was to structure a 'Development and Evaluation Program' that would 'sound out' the new aircraft for the Air Force. Implementation of this programme would be undertaken by the SR-71/YF-12 Test Force at the Air Force Flight Test Center at Edwards. AFSC pilots would work in parallel with their counterparts from Lockheed and ensure the successful development of systems and sensors. Both Phase I Experimental and Phase II Developmental test flying had moved to Edwards, where '953, '954 and '955 were to be evaluated by the ‘blue-suiters’.

In 1965 the team began SR-71 air-refuelling trials (supported by Beale’s 903rd ARS); the aircraft proved adequate for skilled pilots to refuel. Flight envelope expansion proceeded well, as did a host of other tests. On 2 November 1965, Bob Gilliland and Bill Weaver completed the maiden flights of the first two SR-71B pilot trainers (’956 and ’957). By the end of the year, Kelly Johnson could be justifiably pleased with the progress of the latest evolution of the A-12 family.

AIRCREW RECRUITING

US Army Camp Beale was established as a military post in October 1942, when a vast site stretching over 80,000 acres was named in honour of Gen Edward FitzGerald Beale (a mid-19th century western explorer). Acquired by the newly formed US Air Force in early 1948, Camp Beale was used as a bombing and gunnery range during the Korean War. On 27 November 1951, General Order 77 reduced the bombing range by half and created Beale Air Force Base, which was later reduced to 23,000 acres. Between April 1957 and August 1958, USAF engineers constructed a 12,000ft strategic bomber runway at Beale, thus allowing the California base to become home to one of the first SAC B-52 wings.

The 456th Bombardment Wing (BW) operated its B-52s and KC-135s from Beale, alongside the 851st Strategic Missile Squadron’s (SMS’s) first-generation Titan ICBMs. After the 851st SMS was deactivated in 1964, the Air Force informed the press in October that the SR-71 would be stationed at Beale. Soon afterwards, an $8.4-million construction programme was initiated, which included the installation of an array of specialized technical support facilities and 337 new Capehart houses for the incoming personnel.

The official announcement of the new SR-71 unit was made a week before the first test flight of the SR-71, when CINCSAC, General John Ryan, revealed that the 4200th Strategic Reconnaissance Wing would be activated at Beale on 1 January 1965. Three months after the activation of the ‘parent wing’, four permanent support squadrons were formed: the 4200th Headquarters Squadron, the 4200th Armament and Electronics Maintenance Squadron, the 4200th Field

Maintenance Squadron and the 4200th Organizational Maintenance Squadron.

Col John Des Portes was the commander of the new wing while construction works were being carried out at the base. The former U-2 wing commander was soon promoted to brigadier general and given command of the 14th Strategic Aerospace Division, after which Col Doug Nelson took over the SR-71 wing. Nelson was particularly well suited to his new command, since he had been SAC's project officer for the deployment of the U-2 nine years earlier and in August 1961 he had become director of operations for the Oxcart project. Three years later he received a telephone call from Lt Gen Archie Old (Commander of the 15th Air Force), who informed him that he was to be director of plans for the 14th Air Division at Beale, and take over the new wing when Des Portes' promotion was announced.

Nelson's immediate task would be to select a small group of highly competent sub-commanders and SAC fliers to form the initial cadre of the SR-71 unit. Thus he began the necessary planning for the activation of the world's first triple-sonic flying wing. After being assured by General Thomas Power that he would have top priority in choosing the right people for the programme, Nelson set about finding the best maintenance supervisors, flightline and shop personnel, and the best pilots and navigators. General Old agreed that Col William Hayes (later known as the 'White Tornado' for his shock of white hair) 'had to be' deputy commander for maintenance. Nelson recalled: 'Bill Hayes hit the ground running and immediately began selecting his team of maintenance supervisors, crew chiefs and system specialists. That Bill clearly realized our goal of putting together a top-quality maintenance unit was evidenced by the outstanding results that his guys achieved within the first year.'

At the same time, Nelson was interviewing crewmembers for the flying squadron. He first recruited Lt Col Ray Haupt, a former U-2 pilot who was serving as head instructor and standardization pilot on Oxcart at Area 51. He joined the SR-71/YF-12 test force at Edwards AFB, where he became the first Beale pilot to be fully qualified on the SR-71. Ray was to be Beale's chief IP for all new SR-71 fliers.

Steadily, Nelson found the finest officers in SAC for his new, hand-picked organization. The 4200th Medical Group was to be commanded by Col Walt Wright, the most outstanding flight and orthopaedic surgeon in the Air Force. Colonel Clyde Denniston was chosen to supervise all the Category III flight test planning (to prove that the aeroplane could really do the mission for which it had been developed). Top-rated colonels and field grade officers were picked for unique staff positions, and before the end of 1965 the wing had been fleshed out with the necessary talent ‘to make it all happen’.

Meanwhile, Nelson was busy visiting the two B-58 units, the U-2 community, and HQ SAC to review the records of the best pilots and navigator-bombardiers among many highly qualified SAC aircrew members. Many of those whom Nelson considered were SAC’s ‘select’ crewmembers – those who had held spot promotions because of their proven status as SAC’s best. Most of those considered were young enough to undertake another four years of new-generation flying.

From the start, SAC kept its Senior Crown programme as its exclusive preserve, restricting recruitment to select crewmembers from bombers and U-2s. The only exceptions were graduates from the Air Force Test Pilot School at Edwards. Meanwhile, Nelson selected ten B-58 crewmembers: pilots Al Hichew, Robert ‘Gray’ Sowers, Charles ‘Pete’ Collins, Ben Bowles and John Storrie, and navigator-bombardiers Cosimo ‘Coz’ Mallozzi, Richard ‘Butch’ Sheffield, Jimmy Fagg, Tom Schmittou and Dave Dempster.

Colonel Doug Nelson (second from right) takes formal delivery of Beale’s first SR-71, two-seat trainer ’956, from Palmdale plant manager Bob Murphy on 6 January 1966. (Lockheed Martin via Bob Murphy)

During a flight test sortie on 25 January 1966, aircraft 61-7952, seen here on the tanker boom, became the first SR-71 to be lost in an accident. (Lockheed Martin via Tony Landis)

They arrived at Beale to begin preliminary training after having completed the tough 'astronaut's medical exam' at Brooks AFB near San Antonio, Texas. Since there were no aircraft at Beale, it was arranged that the ten would undertake a seven-week training course on the SR-71 at the Skunk Works. They would be able to spend time with key Lockheed engineers, including Kelly Johnson and Ben Rich, and would write up lesson plans for a Combat Crew Training School that they would later establish at Beale. They would become the instructor cadre to train the SR-71 crew that would follow.

At the end of the Burbank course, Doug Nelson (who had been monitoring the progress of all ten) called them together and told them that since they were on a par with one another academically and professionally, he would have to make a purely arbitrary decision based on age. Since John Storrie and Dave Dempster were the youngest, they would get some preliminary flying time at Edwards and go to The Ranch for flying training in the 'Tin Goose' (the AT-12), prior to returning to Beale. Another crew would go back to Beale to get the flight simulator programme started and lessons planned for follow-on crew training.

At the same time, many others had applied to join the Senior Crown force. At Air Command and Staff College at Montgomery, Alabama, three former SAC select crewmembers who had flown B-47s and B-52s and one general's aide who had flown B-47s were selected on the orders of CINCSAC General Joseph

Nazarro, who instructed his Director of Personnel, Col Lester Miller, to use SAC's best resources to man the new system.

Consequently, Majs Jerry O'Malley, Don Walbrecht and Larry Devall, and Capt Connie Seagroves made the early cut without meeting Col Doug Nelson. Since there were no SR-71s at Beale, these early arrivals formed the flying squadron and managed the early activities at unit level (mobile control for T-38 flying, SR-71 simulator buddy-crew instructors, etc). As they had 'jumped the queue' and arrived ahead of all but a few of the B-58 selectees, General Des Portes interceded for his U-2 pilots and assigned them earlier checkout numbers than the B-47/B-52 inputs. As a result, U-2 pilots Pat Halloran and Buddy Brown got precedence, as well as test pilots Bill Campbell and Russ Scott. When the final crew list shaped up between late 1965 and early 1966 it read as follows, since Russ Scott had dropped out and others had arrived:

Crew 01: Maj John Storrie (B-58 and Capt Cosimo Mallozzi (B-58)
Crew 02: Maj Robert Sowers (B-58) and Maj Butel Sheffield (B-58)
Crew 03: Lt Col Al Hichew (B-58) and Maj Tom Schmittou (B-58)
Crew 04: Capt Pete Collins (B-58) and Capt Connie Seagroves (B-52)
Crew 05: Maj Jack Kennon (B-58) and Capt Cecil Braeden (B-58)
Crew 06: Capt Bill Campbell (Test Pilot School) and Capt Al Pennington (B-58)
Crew 07: Maj Pat Halloran (U-2) and Capt Mort Jarvis (B-52)
Crew 08: Maj Buddy Brown (U-2) and Capt Dave Jenson (B-52)
Crew 09: Capt Dale Shelton (B-58) and Capt Larry Boggess (B-58)
Crew 10: Maj Jerry O'Malley (B-47) and Capt Ed Payne (B-47)
Crew 11: Maj Don Walbrecht (B-47) and Capt Phil Loignon (B-47)
Crew 12: Capt Earle Boone (B-58) and Capt Dewain Vick (B-52)
Crew 13: Capt Tony Bevacqua (U-2) and Capt Jerry Crew (B-52)

In addition, a number of other officers were on hand, or had been identified, for check-out positions sometime in the future, but did not have crew identity until later. These pilots were Jim Watkins (KC-135), Larry Devall (B-52), Bob Spencer (U-2), Roy St Martin (U-2), George Bull (U-2) and Bob Powell (U-2). The RSOs were Dave Dempster (B-58), Clyde Shoemaker (B-52), Ruel (Keith) Branham (B-52), Bob Locke (B-52), John Carnochan (B-58), Charles McNeer

(B-52) and Bill Kendrick (B-52).

The first five crews were still at Edwards and The Ranch getting some preliminary flying in T-38s and the AT-12 to become the first instructor pilots. Kennon, Braeden, Bowles and Fagg stayed on at Edwards with the test force.

A typical RSO candidate was Spot Maj Ed Payne at Mountain Home AFB, who had applied for the programme. His background was similar to that of most navigator-bombardier/RSO applicants at the time. He had joined the USAF only nine years before and had become a radar-bombardier on B-47 Stratojets. In 1962, as a 'spot-promoted' captain with the 303rd BW at Tucson, Arizona, he and his crew had won ten of 22 trophies at SAC's annual navigation and bombing competition. In May 1964 the 303rd BW deactivated, whereupon Ed was given orders to report to the 92nd BW at Spokane, Washington, which was equipped with B-52s.

> My squadron commander urged me to trade the assignment with another bombardier so we could retain our 'spot' promotions to major a year longer by transferring to Mountain Home, Idaho, where we could continue to fly B-47s. I accepted my boss's advice and moved to Idaho with the rest of our crew.
>
> One day later, at the Standardization Board Office where our crew was assigned as flight evaluators, a young crewmember beamed, 'I know where I'm going, I know where I'm going!' I looked at a copy of the message that told of the qualifications for entry into a strange programme. I talked over such an assignment with my wife Millie and the next day I completed an application for duty as an RF-101 'pilot'.
>
> Three weeks later I was notified that I'd been selected for an interview at Beale. The instructions informed me to travel in civilian clothes from Boise, Idaho to Yuba City, California. On the final leg of the flight, another passenger asked me if I was Payne, Vick or Jarvis. I admitted my identity, whereupon Larry Boggess introduced himself. 'How did you know who I was?' I enquired. 'You're wearing a hack watch, Air Force sunglasses, and have a good haircut,' replied Larry, 'and those two guys up front must be Dewain Vick and Mort Jarvis,' he commented.
>
> The interview at Beale was conducted in an old World War II building. A secretary in civilian clothes first called Dewain Vick into the office for the interview; he was followed by Mort Jarvis and me. Larry Boggess was last in that day. When I walked in and saluted, I noted that Col Doug Nelson was wearing an orange-coloured flight suit complete with an RF-101 patch. As the tall, slim colonel read through my personal records, he said 'welcome to Beale, Capt Payne'. Looking up, he saw my gold major's leaves and apologized for the mistake, to which I replied, 'Oh well, sir, easy come, easy go,' referring to the temporary nature of SAC's spot promotions.
>
> Colonel Nelson told me he was indeed hoping for an all-spot team. The interview was very short. Nelson asked a few personal questions, then enquired whether all the RSO applicants were 32 years old with five children like me, since the other two had been! He then asked if I would be prepared to fly over enemy territory, to which I replied, 'Of course'. I was told that I had passed the interview and was 'hired' pending passing the physical examination in Texas.

Back at Mountain Home, Ed received orders to attend a ten-day medical exam at Brooks AFB, Texas in April. Prior to the exam he completed a 505-question paper asking all about his previous state of health. Ed recalled that the detail was 'incredible'. One question asked: 'Have you ever worked in or around a silo?' Since he had grown up on a Montana cattle ranch, he answered 'yes', and had to see a specialist at Brooks who checked him over for silo fever, a condition that a person working every day in wheat dust might contract from the poor-quality air one would breathe. Ed explained that during a summer vacation from school he had worked as a carpenter's helper repairing a silo. Such was the detail of the examination, which was the same as that used by NASA in its selections for the astronaut programme.

He was given a clean bill of health and returned to Idaho. While he awaited further orders, it was announced that the 9th BW was to deactivate on 1 January 1966. On that date, Ed lost his spot promotion and returned to the rank of captain. He was in contact with Col Nelson at Beale, who told him that they had no aircraft to commence the training programme, but that the 4200th SRW was inheriting the 9th BW's 'historical number', which dated from World War I, so it would be called the 9th Strategic Reconnaissance Wing (SRW) after 25 June 1966.

On Nelson's instructions, Ed gathered up all of the 9th's heraldic items, pictures, trophies, battle flags, unit histories and other paraphernalia relating to the wing and its squadrons, the 1st and the 99th, and packaged them for shipment. Another RSO (Capt Connie Seagroves), who was already at Beale, came to Mountain Home in a DC-3 to collect the boxed treasures. Ed reported to Beale in April 1966 to team up with Maj Jerry O'Malley, who had arrived from Maxwell AFB ten months earlier.

The first two of eight Northrop T-38 Talon trainers arrived at Beale on 7 July 1965. These small, agile white jets (widely used as trainers with Air Training Command) would be used as 'companion trainers' to maintain overall flying proficiency for the SR-71 crews at a fraction of the cost of flying the main aircraft. They were also to be used as 'pace-chase' aircraft to accompany every SR-71 flight during the first year of Beale operations, to observe landing gear positions and to give crew and staff pilots an opportunity to practise formation flying. Because of the T-38's size alongside the SR-71, one of the wives jokingly called the two aircraft 'the horse and the horsefly' when they first appeared together over Beale.

Doug Nelson recalled that the T-38s were obtained only after a long and traumatic battle with SAC Headquarters over the companion trainer issue:

> Even though the need for such an aircraft to augment the SR-71 fleet had been clearly demonstrated in the A-12 programme in Nevada, I had considerable difficulty convincing some of the senior staff people at HQ SAC and at HQ 15th Air Force. I think the argument that finally won them over had to do with the fact that some of these same people had already been expressing the view that I should consider selecting SAC B-52 bomber and KC-135 tanker pilots for entry into the programme, as well as supersonic B-58 pilots, test pilots, U-2 pilots and former fighter pilots. I agreed that this could probably be done, but was really only feasible if they could be put through a 'lead-in' training course conducted by us at Beale in an aircraft such as the T-38. Other alternatives I suggested included the F-5B, F-101F and F-104B. They settled on the T-38 as the obvious choice and went all out to obtain eight of them from Training Command.

In December 1965, Maj Don Walbrecht flew Lt Col Ray Haupt to Palmdale, where Haupt and Charlie Bock (USAF acceptance test pilot at Edwards) picked up the SR-71B trainer (64-17957) from Plant 42 and test-delivered it a few miles away to Edwards, where it underwent further acceptance testing before it was ready for delivery to Beale.

At 2:00pm on 6 January 1966, Col Nelson and instructor pilot Haupt made the first pass of an SR-71 over Beale to deliver the trainer to SAC's 9th SRW. Soon after, Storrie and Collins would be able to finish their pilot checkouts. Four months later, Col Nelson and Maj Al Pennington took delivery of Beale's first SR-71A, 64-17958. From then on, crew training and Category III operational testing could proceed in earnest.

FIRST LOSS

On 25 January 1966, Bill Weaver and Jim Zwayer took off from Edwards in SR-71A '952 using call sign 'Dutch 64'. Both were Lockheed flight test employees. The two main objectives of their mission were to evaluate navigation and reconnaissance systems, and investigate procedures for improving high-Mach cruise performance by reducing trim drag. This research required that the CG be moved further aft than normal to compensate for the rearward shift of the centre of pressure at high Mach.

After in-flight refuelling, Dutch 64 climbed back to cruising altitude. While the aircraft was in a 30° bank to the right at approximately 80,000ft and a speed of Mach 3.1, an inlet scheduling malfunction occurred, followed by an unstart of the right engine. The cumulative effect of the inlet malfunctions, CG configuration, speed, altitude and attitude resulted in pitching and yawing forces that exceeded the restorative authority of the flight controls and the SAS. This combination of rapid out-of-control actions led to the breakup of the aircraft, with the entire forebody becoming detached from the main body.

As soon as it became apparent that the situation was hopeless, Bill tried to tell Jim what was happening and to try and remain in the cockpit until they were down to a lower speed and altitude, since he did not think it would be possible to eject successfully under such stressful conditions. Unfortunately, as revealed upon subsequent recovery of the cockpit voice recorder, most of Bill's words were unintelligible due to the incredibly high G forces that both men were being subjected to at the time. At that point, Bill blacked out and to this day still does not know how he escaped. Indeed, his ejection seat was found inside the cockpit section of the wreckage.

During the break-up, the cockpit canopies were blown off and a combination of G forces and air loads had blown both men clear, as Bill later explained:

> I thought I was having a bad dream and hoped that I would wake up and all this would go away. However, as I began to regain consciousness, I realized it was not a dream and that this had really happened. At that point, I thought I was dead because I was convinced that I could not have survived what had happened. I remember thinking that being dead wasn't so bad after all. I had a kind of detached, euphoric feeling. As I became more conscious, I realized I wasn't dead after all, and that I had somehow became separated from the aircraft. I couldn't see anything as my visor had iced up.

Lockheed flight test pilot Bill Weaver miraculously escaped the 25 January incident, but flight test engineer Jim Zwayer was killed. (Lockheed Martin via Tony Landis)

My pressure suit had inflated, so I knew the emergency oxygen supply in the seat kit attached to my parachute harness was functioning. This source provided breathing oxygen and pressurization essential at those altitudes, and physical protection against the intense buffeting and G forces I had been subjected to. It was like being in one's own life support capsule. After realizing that I wasn't dead and that I was free of the aircraft, I was concerned about stability and not tumbling at such high altitude. Centrifugal forces sufficient to cause physical damage can be generated if the body tumbles at high altitude where there is little air density to resist spinning motions. Fortunately, the small stabilization 'chute, designed to prevent tumbling, had worked fine.

My next concern was the main 'chute – would the barometric automatic opening device work at 15,000ft? I certainly hadn't made a proper exit – I knew I had not initiated the ejection procedure. How long had I been blacked out and how high was I? I was about to open the faceplate so I could estimate my altitude above the terrain and locate my parachute's 'D' ring. At that moment, I felt the sharp, reassuring tug which indicated that the main 'chute had deployed. This action was a very reassuring feeling, believe me.

I then managed to raise my faceplate and noted that the visibility was just incredible. It was a clear winter's day at about three o'clock in the afternoon, and from my vantage point beneath the canopy it appeared that I could see for a couple of hundred miles. But what made everything just perfect was that about a quarter of a mile away was Jim's 'chute. I was delighted because I didn't believe either of us could have survived, and to think that Jim had also made it gave me an incredible lift.

I couldn't manipulate the risers to steer my 'chute because my hands were frozen and I needed one hand to keep my iced-up visor raised (the up-latch was broken). As a result, I could only see in one direction and the terrain wasn't all that inviting. I was convinced we'd have to spend the night out there and I was trying to think of things I had been taught in survival training. I landed okay and was trying to undo my parachute harness when I heard a voice say, 'Can I help you?' I looked up and there was a guy walking towards me wearing a cowboy hat and behind him was a helicopter. He turned out to be Albert Mitchell, whom I later learned owned the huge cattle ranch in northeast New Mexico upon which I had landed. He helped me out of the 'chute, told me he had radioed the police, the Air Force and the nearest hospital and then said, 'I saw your buddy coming down, I'll go and help him.'

He climbed into his little helicopter and was back a few minutes later with the devastating news that Jim was dead. I asked him to take me over to see Jim and after verifying that there was nothing that could be done, other than have his ranch foreman watch over the body until the authorities arrived, he flew me to Tucumcari hospital about 60 miles away to the south. I have vivid memories of that flight as well. I didn't know much about helicopters, but I knew a lot about red lines, and the airspeed needle was above the red line all the way to Tucumcari. I thought about the possibility of that little thing shaking itself apart in flight and how ironic it would be to have miraculously survived the previous disaster only to be finished off in the helicopter that had come to my rescue! We made it without mishap and on reaching the hospital I was able to phone Lockheed Flight Test at Edwards. They knew the aircraft had been lost after loss of radio and radar contact, and just didn't believe that I had survived.

Colonel Doug Nelson accepts delivery of the 9th SRW's first SR-71A, '958, on 10 May 1966. (Lockheed Martin via Bob Murphy)

POST SCRIPT

The solution to reducing the excessive trim drag problem was to move the centre of lift forward, thus reducing static margin and trim drag; this was achieved by Kelly inserting a 'wedge' between the aircraft's forward fuselage and its nose section. The result was the distinctive 2° nose-up tilt.

During the closing stages of 1966, the SR-71 underwent a series of anti-skid brake trials. Bill Weaver conducted most of these and on 10 January 1967 was due to evaluate the system with the aircraft at maximum gross weight and standing water on the runway. By a twist of fate, he was unable to conduct this particular test because of the funeral of his friend Walt Ray, who had been killed a few days earlier in an A-12 accident up at Area 51. Art Peterson was substituting for Weaver and the RSO position remained empty.

END OF THE PROTOTYPE

During the trial, ’950 had entered the flooded test area of the Edwards runway at well over 200kt, however when the brake ’chute was selected, it failed to deploy properly. The wheel brakes remained ineffective until the aircraft had cleared the water and once on a dry surface, the brakes locked the wheels and all six main tyres blew. As momentum carried the aircraft onward, the brakes burned out and the magnesium wheel hubs were consumed on the concrete runway, triggering an even greater fire.

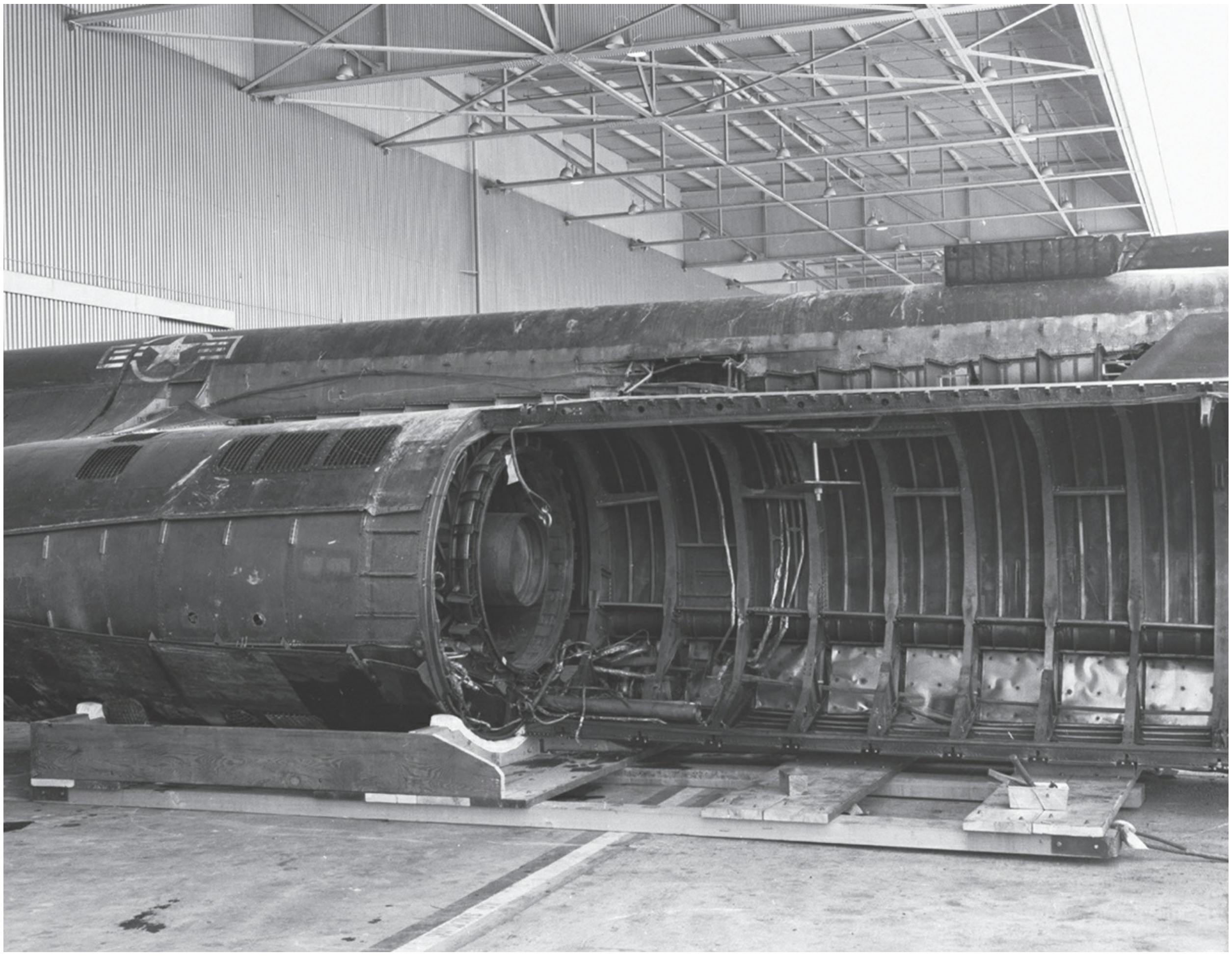
Peterson skilfully retained control of the stricken aircraft until he ran out of runway, albeit riding on the main gear stumps. On the overrun, one of the main gear legs dug into the dry lakebed, causing side forces to rip the nose leg off. This sudden breakage stopped the aircraft and broke its back. Fire quickly spread to engulf the entire machine, but Peterson managed to extract himself from the cockpit, in the process sustaining back injuries that would ground him for several weeks. The accident was the end of the line for the SR-71 prototype, Article 2001, which was written off as ‘beyond repair’.

TRAINING AND CATEGORY III TESTING

Aircrew training content constantly evolved over the SR-71’s lifespan, reflecting modifications made to the aircraft and lessons learned. Training techniques, however, changed little over 25 years. The aircrew curriculum consisted of three phases of progressive activity that readied pilots and RSOs for the move from a variety of other jets into the highest performance aeroplane in the world. At first, crewmembers accumulated many hours in the flight simulator before beginning their inflight training.

The pilots, after completing the elongated simulator course during which they had endured every conceivable emergency procedure, and many T-38 flying hours, were introduced to the SR-71B, which they all recognized as ‘friendly’. The B-58 pilots found it particularly easy to fly. Most other aircrew also found that flying the SR-71B was simply an extension of their former jet flying, no matter what principal type they had flown. The new pilots (under the supervision of Haupt or Hichew) found that the first sortie flown in the SR-71B was ‘tame’, and it proved both easy to fly and land.

The first training sortie was accomplished at subsonic speeds under the supervision of an instructor pilot, who evaluated the new pilot’s ‘first performance’. This indoctrination flight included touch-and-go landings and confidence-building manoeuvres that soon made the aircraft feel like an old friend. Two more instructor-supervised sorties followed, adding air refuelling practice, while a third included an acceleration to Mach 3.0 and a descent, an approach culminating in GCAs, ILSs and more landings.



The SR-71A prototype was written off following an accident during an anti-skid brake evaluation on 10 January 1967. The remains of the forward fuselage and part of an engine nacelle are seen in storage at Palmdale. (Lockheed Martin via Tony Landis)

The fifth flight was a three-hour evaluation sortie, which reviewed the student's total performance to assure that pilots were ready to take their own simulator-trained RSOs on six more crew-training sorties before both crewmembers could be declared 'qualified'. Sorties lasted between three and five hours and consisted of 'combat-oriented' missions that included emergency navigation legs at Mach 3.0 to demonstrate that large errors could develop unless headings were held for long distances.

The crew then undertook a simulator check ride. This no holds barred evaluation tested the crew's ability to control serious inflight emergencies that involved flight judgment and crew coordination of high standards. A few days later, the crew flew a long profile, after which instructors reviewed every voice transmission made during the mission and the MRS record; their ability to fly a mission profile to the letter was evaluated by the use of the latter device. After crews were declared 'combat ready', they continued clocking up hours by performing Category III Operational Test Flights.

During operational testing, two major areas of concern were focused upon – the aircraft's inlet control system and the effects of the prolonged heat soaks during high-speed flight. As far as the former was concerned, crews were often subjected to sharp and distracting unstarts and an immediate solution to the problem was to operate the inlet system in the manual mode, with the pilot controlling the spike and door positions with switches while reading their changing positions on cockpit instruments. Such manual operations took up an undue amount of the pilot's attention at high speed and resulted in off-optimum inlet operations, but though less efficient, they often allowed new flyers to complete more training missions and accumulate data for the Phase III test programme.

The SR-71 was not 'cleared' for top speeds during Cat III test flying and training for most of 1966, an initial restriction speed of Mach 2.6 being applied. By mid-year the limit was raised to Mach 2.8, and by December Mach 3.0 was allowed. Finally, in early 1967 all aircraft were cleared to fly at the design limit of Mach 3.2. Since SAC allowed its wing commanders to be fully qualified in their unit's aircraft, Col Doug Nelson teamed up with senior staff RSO Col Russ Lewis and formed 'Staff Crew Number One'. They undertook the full aircrew course at Beale, completing their certification in September 1966. Soon after, they flew SAC's first ever Mach 3.0 flight.

As training began in earnest around the western US, the Air Force began receiving lots of sonic boom complaints. Most of the heavy booms were attributed to operations in the ascent and descent phases when the SR-71 accelerated or slowed. The 'nuisance factor', rather than real damage, caused Congress to instruct the USAF to modify its training routes to avoid flying over large urban areas.

The township of Susanville situated just north of Beale on the 006° radial of the Sacramento VORTAC knew a great deal about sonic booms. During the first 18 months of flight operations, SR-71s were cleared by FAA flight controllers to accelerate and climb supersonically on that radial. On reaching FL330 and Mach 0.9, the pilot would push the nose below the horizon to quickly accelerate beyond the Mach while descending to FL270, before starting another climb at Mach 1.25. The intensity of a sonic boom is dependent upon the slant range from the aircraft to the ground along the shockwave, poor Susanville, nestled high in the Sierra Nevada foothills, sat directly in slant range and was taking a real hammering.

Prolonged flights in a full pressure suit could be uncomfortable, especially with a full bladder. For this reason, a urine collection device (UCD) was developed for a 'suit-dry' method of eliminating fluid body waste. Urine could be discharged into a condom-like receptacle that was tube-connected to a plastic collector bag donned prior to suiting up.

One crewmember described his pre-UCD inflight urination experience with the 'jug' in the following terms: 'Wearing pressure-suit gloves, undoing several zippers and fighting through 4in. of pressure suit wasn't easy.' Maj Dave Dempster was on a three-hour training sortie in April 1966 in '958, with Maj John Storrie, when he was confronted with a full-bladder problem. His S-901J pressure suit had not yet arrived from the Clark Company and he had borrowed a suit from a similarly tall colleague.

The demands of nature had become irresistible and Dave mentioned this unpleasant fact to John. Most crewmembers were very reluctant to use the 'jug' because (unlike with the later Urine Collection Device (UCD)) suit integrity was not maintained and bloodstream re-nitrogenation was likely. John, after devoting some thought to Dave's problem, said, 'Well, the way I see it, you can either hold it in or let it go in your suit – by the way, whose suit are you wearing?' Dave replied, 'Col Nelson's.' That thought provided him with all the encouragement he needed to wait until he landed!

The first two years of operating the SR-71 at Beale were crammed with training and testing activity. More and more crews were building up flying time and testing the aircraft's ability to do its intended mission.

In November 1966, Capt Earle Boone and Capt Dewain Vick climbed into '966 for their first flight together. Their families were proudly witnessing the event from the Physiological Support Division (PSD) van. They had just cranked engines when one caught alight and fire engines converged on the 'hangar barn' from all points of the compass. The crew evacuated the aeroplane and the fire was quickly extinguished, with minor damage to the aircraft. Earle and Dewain transferred to another SR-71 and were able to complete their sortie; various problems caused the loss of up to 20 per cent of the early training sorties.

Precautionary landings away from Beale were also frequent during this early period. Typical of many diversions were those of Jerry O'Malley and Ed Payne, who landed at Hill AFB, Utah, with a generator problem. They recovered the very same aircraft into Buckley Field, Colorado a week later with the opposite generator inoperable. A few weeks later they lost a fillet shortly after take-off. The aircraft piece was found by a resident near Beale, who turned it over to the County Sheriff, who in turn passed the 9ft length of black skin back to the 9th SRW.

Captain Earle Boone ejected safely from SR-71 '966 on 25 October 1967 having entered a deep-stall after tanking. It was the 9th SRW's first SR-71 to be lost in an accident. (USAF via Tony Landis)

Base officials identified the missing part as belonging to Jerry and Ed's aircraft. As Jerry prepared to refuel near Walton Beach, Florida, he asked to pull farther forward so the KC-135 crew could look at the rear of his aircraft. The boomer had reported that 'the ass-end of the aeroplane was missing.' Since the aircraft had just transited the US without the slightest indication of a problem, and the boomer had relayed to the crew that 'the panel appeared to merely cover some plumbing,' Jerry refuelled with the intention of returning to Beale 'high and hot'.

Ed reported the crew's intention via HF radio to the Beale command post, whose officer controller passed the information on to HQ 15th Air Force and SAC. Ed got a return call from the 15th Air Force command post instructing him to divert into Barksdale AFB, Louisiana – this order was not queried as it came from Lt Gen P. K. Carlton, commander of the 15th Air Force.

Jerry landed on the southern end of Barksdale's long runway, jettisoned the drag 'chute at 50kt and switched off the anti-skid brakes, as per the checklist. At that point, the SR-71 entered a 1in. deep puddle of rainwater and slewed into a sideways skid down the runway. As it exited the hydroplaning skid and touched dry runway, all six tyres blew. It was three days before Jerry and Ed could return to Beale. When they suited up for the flight home, PSD technicians accidentally interchanged their 'moon suit' helmets, which caused acute discomfort to Jerry on the four-hour slow flight back to northern California.

FIRST BEALE ACCIDENT

On 13 April 1967, Capt Earle Boone and Capt Dewain Vick were scheduled to fly their ninth training sortie, a night flight that included air refuelling and a Mach 2.8 run over the southern United States. During the pre-flight medical exam it was discovered that Vick had a cold that precluded him from clearing his middle ear pressure because of a swollen Eustachian tube. As a consequence, the flight surgeon grounded Dewain, and Butch Sheffield, the buddy-crew RSO, was substituted. It would turn out to be a very long night for the two fliers.

After completing air refuelling near El Paso, Texas, Earle (an experienced B-58 pilot) decided to turn after leaving the tanker to avoid a thunderstorm that lay ahead on their planned track. Earle had started a subsonic climb to perform the 'dipsy-doodle' manoeuvre to hasten the transonic breakthrough, but during the climb the fully fuelled aircraft's airspeed fell below the desired 0.90 Mach profile. To regain lost momentum, Earle lowered the nose below level flight, but when he subsequently pulled the stick back, the heavy jet shuddered in an accelerated stall. He fought hard to regain control of '966, but its angle-of-attack became uncontrollable and it suddenly entered a pitch-up rotation from which there was no recovery.

Both crewmembers ejected from the aircraft, which had broken in half and spewed a great shroud of fuel around them. Since Butch ejected first, his ejection-seat rocket ignited the fuel into a fireball, through which Earle ejected a second behind the RSO.

The New Mexico surface winds were gusting at up to 40kt when the pilot and RSO hit *terra firma*. Their wild ride across the desert floor ended in a cattleman's barbed-wire fence more than half a mile from initial touchdown.

Neither was seriously injured, although for the next few days Earle had blisters along the back of all eight fingers, and both suffered considerable bruising and stiffness from their night parasail ride across a part of New Mexico not too far from the site of Bill Weaver's crash in '952.

A great deal was learnt from this accident, which was largely attributable to the pilot 'trying to do too much too soon' in an aircraft that was still being tested. Similar flight conditions were re-flown in the SR-71 flight simulator by the other crews, and it was found that heavyweight accelerated stalls would be extremely difficult to recover from, and that secondary stalls could induce the dreaded pitch-up phenomenon, particularly at night or in clouds. SAC also began to realize that night work was being done too early in SR-71 transition training. At the same time, it was decided that all flights, including subsonic movements, should be in pressure suits for improved aircrew protection.

Captain Richard 'Butch' Sheffield was Boon's RSO and, like his pilot, successfully ejected from '966. (USAF via Tony Landis)

Eventually an automatic pitch warning (APW) system was added. This device was far superior to the original system, and following its installation no further aircraft were lost through stalls.

A serious incident that could very easily have resulted in an aircraft being lost was experienced by Maj Bob Spencer and Capt Keith Branham on a subsequent mission, as they approached the Great Salt Lake on their return to Beale. Bob Spencer began feeling unwell, and before he was aware of the nature of his problem, he started to hyperventilate. In his reduced state of consciousness, Spencer realized that his oxygen supply had somehow been cut off, so he yanked the 'green apple' oxygen flow-starter knob on the emergency supply in his parachute's survival seat pack, which unfortunately fed into the same supply lines through which the aircraft main oxygen flowed.

Since he was high and hot, he realized that he was getting into deep trouble. The oxygen connections were located low on the right side of the ejection seat, but were out of reach. The SR-71's cockpit was pressurized to 26,000ft, which left Bob groggy and suffering from narrowed vision at a pressure altitude higher than most mountains. Now suffering from hypoxia, he told Keith that he was having oxygen problems and might need advice to better control a ragged descent.

At that point he reduced power and adjusted the pitch attitude on the autopilot. As the aircraft began to exceed the KEAS and Mach limits during descent, Bob grunted to open his 'gun-barrel' vision in an attempt to read the TDI instrument, which displayed Mach, KEAS and altitude. For the next ten minutes Keith shouted instructions to Bob to keep him from exceeding the dangerous low or high-speed limits that could result in loss of control.

Bob and Keith brought the aircraft down to 15,000ft, where Bob snapped out of his condition, or so he thought. He 'felt so good' from the raptures of hypoxia that he convinced Keith that there was no need to divert into Hill AFB. After Keith computed that they had enough fuel to reach Beale at Mach 0.90, Bob headed for California. Halfway home, the right engine flamed out. Bob looked at the fuel pressure warning light, which had not illuminated, indicating that the flameout was not due to fuel mismanagement. He tried unsuccessfully to restart the engine, which left them in a less fuel-efficient condition since the rate of fuel use on one engine was much higher than normal.

They called the Beale command post, where the controller ordered a tanker to be scrambled to meet them over Nevada. Twenty-five minutes later, the tanker approached the rendezvous point, but initiated the 180° join-up turn much too late, and Bob and Keith saw their much-needed supply of JP-7 fly straight past them. To re-join with the tanker, which was now well in trail, would use even more of their precious fuel, and they couldn't risk this. Luck, however, was on their side, and they recovered into Beale with very little fuel aboard.

The next day Bob and Keith listened to the voice recording and examined the read out from their MRS. In his hypoxic state, Bob had been left disbelieving of the predicament they faced, and he was stunned to hear his voice recordings. He realized how the lack of oxygen had made his responses sound absurd and he began to wonder if the flameout had also been self-induced due to his mismanagement. That flight was a stark lesson in the dangers of hypoxia. The aeroplane's oxygen system was quickly modified so the primary and emergency oxygen supplies were independently routed.

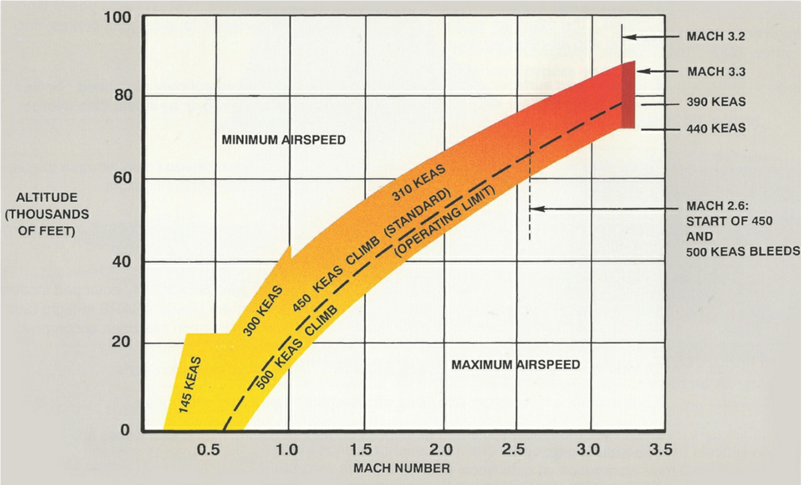


Table showing the KEAS climb schedule to cruise speed and altitude. (Lockheed Martin)

Russ Scott, a fighter pilot who had been an Air Force Test Pilot School graduate and a Gemini astronaut candidate prior to being eliminated due to his excessive height, became impatient with the slow progression of SR-71 pilot checkouts and requested a move to the remnant A-12/F-12 programme. After an Oxcart checkout, he flew the YF-12 briefly, then joined Ling-Temco-Vought as an A-7 production test pilot. Later he was chief test pilot on Northrop's F-20 Tigershark.

His departure from Beale in 1966 altered the crew line-up. John Storrie was then teamed up with 'Coz' Mallozzi, since they had flown together in B-58s. Dave Dempster 'inherited' Jim Watkins, a pilot recruited from Beale's 903rd ARS, flying KC-135Qs, into the 1st SRS staff as ops officer; Watkins had all the security clearances required by the Oxcart programme. Due to his progressing years, master joke-teller Jim took a lot of good-natured ribbing from his younger squadron colleagues, occasionally wearing a World War II leather flying helmet to reinforce the 'old pilot' image.

Jim Watkins and Dave Dempster flew their first SR-71 sortie together in '959 on 21 February 1967. As they progressed in their training, they flew weekly sorties, including a training sortie along the 'Kitty Three' route in '972 on 2 July 1967. The mission plan called for them to head east on a standard refuelling course across northern Nevada, accelerate east over Idaho and Wyoming, turn south to Texas, and west over New Mexico to make a photo run on San Diego, then north past San Francisco before returning to Beale.

On the eastbound leg over Wyoming their ANS failed and should have resulted in an abort of the high and hot portion of the flight and a subsonic return to base via airway routes. Since they were aware that the Senior Crown reconnaissance programme would soon be moving to cover the Vietnam War, Jim and Dave were reluctant to lose an opportunity of flying a hot leg, especially when they had the chance to attempt emergency navigation training while being backed up by the stateside VORTAC radio navigation system, which told them where they were along the route. They reasoned that should an ANS failure occur when crossing the Pacific, they would have to continue 'at speed' because of fuel considerations.

They continued to Mach 3.0 and cruise altitude using the aircraft's attitude heading reference system, its compass systems and ground-based TACAN transmissions for heading and location references. While 'whistling along' at Mach 3.0 they failed to note the precession in their magnetic compass, and when ATC at Tucson, Arizona, said: 'Aspen 21, you are now leaving the state', they did not understand the significance of the message. It was not until Dave checked their position using TACAN and the ground view-sight that he realized they had left Arizona and violated Mexican airspace. Instead of their tracking camera showing images of San Diego's harbour, it featured photographs of Ensenada, Mexico.

After a 'chewing out' by 9th SRW officials for violating the Go-No-Go checklist, they joked that they were the first to fly an SR-71 on an 'international sortie'. Before long, crews were instructed to practice a transcontinental emergency navigation leg when returning across the middle of the US.

Ten days later, Jim and Dave were airborne in '972 on a routine sortie that was typical of flights at that stage in the SR-71's development. They had climbed north from Beale into Washington and descended into Montana for refuelling. While climbing back to high altitude there was a loud bang as the left engine unstarted. The aircraft yawed hard into the dead inlet, but the SAS and autopilot kicked in right 'rudder' to maintain track.

SR-71A 61-7965 was the second Beale SR-71A lost in an accident. (Lockheed Martin via Tony Landis)

But the unstart was so strong and the yaw angle so great that the right inlet unstarted and the engine compressor stalled. Jim fought to maintain control as '972 suffered repeated unstarts and began a descent that finally ended in stable flight at 29,000ft. When '972 returned to Beale, inlet technicians found that the linear voltage transducer within the left spike had suffered a 'hard-over' failure, and was not reacting to voltage signals from the analogue automatic inlet control system. At the time of the first unstart, the left spike had moved forward during the recapture cycle and remained extended, rendering shock wave recapture impossible. In the squadron's flight lounge, such experiences were shared as things to watch out for when flying this still-to-be-proven aircraft.

MORE INCIDENT AND LOSSES

As the 9th SRW approached the time for overseas deployment, much talk in the crew lounge was devoted to anti-SAM tactics. The plan was to penetrate enemy airspace at Mach 3. If fired upon, the pilot would increase speed to Mach 3.2 and climb, thereby forcing the missile's guidance system to recalculate the intercept solutions. Some crews considered jinking options, but such manoeuvres were discounted since they would only disrupt effective intelligence gathering.

One half-baked consideration was to dump fuel to become lighter for a more rapid climb, but Watkins and Dempster ended that argument once and for all on a winter training sortie, dumping fuel for ten seconds high over Montana to see if the afterburner might ignite it. The fuel instead turned into an instant ice cloud in the -55°C stratosphere, leaving a 5-mile long contrail 'pointing' directly to the aircraft. Jim Watkins reported that he could see the trail for hundreds of miles after they had turned back towards the west.

On the night of 25 October 1967, a black-tie dinner was being held at the Beale Officers' Club, with Kelly Johnson as the guest of honour. Major Roy St Martin and Captain John Carnochan, however, were scheduled to fly a three-hour night training sortie. Using the SR-71 stateside training callsign Aspen, Aspen 28, serial '965 departed Beale at 4:58pm on route Papa. This consisted of a high-altitude, supersonic leg to Busy Palace, an air refuelling area near Albuquerque, followed by a second climb and acceleration east of Denver before turning onto a westbound leg, to return to Beale north of Salt Lake City.

The sortie progressed well through the air refuelling and second acceleration to supersonic cruise. Roy began his descent and deceleration in the vicinity of Elko, Nevada – about two hours 15 minutes after take-off. Having eased the throttles back and reset them to 6100RPM, he observed a warning flag on the bank steering bar of the Attitude Director Indicator (ADI), and that the autopilot had also become disconnected. The ADI showed wings level flight and the Horizontal Situation Indicator (HSI) indicated that the aircraft was maintaining a straight (not turning), course. In response to the warning flag on the ADI, Roy switched the attitude reference source to the Flight Reference System (FRS). This action resulted in the ADI immediately displaying a 'unusual attitude of undetermined magnitude'. Both the warning flag on the steering bar and the OFF flag on the ADI appeared simultaneously. Roy then advised John that he had attitude indicator malfunctions and the RSO responded by informing the pilot that his Astro Navigation System (ANS) had stopped functioning as a valid reference source. Switching to FRS and checking his ADI, John informed Roy that according to his reference source, the aircraft was in a left wing low, diving turn. But due to such a radical reading, John believed that his FRS had failed and reported it as such to Roy – however, there were no OFF flags on his ADI. Switching his source back to ANS, the ADI indicated wings level and constant heading. In fact, '965 was making a 180° turn towards the east, as observed by Oakland Air Traffic Control Center. In addition, its speed had increased to 480 KEAS, contrary to the fact that Roy believed that he had stopped the speed increase. There was no visible horizon at high altitude over Nevada at 8:25pm in the late autumn and the few scattered ground lights merged easily with the stars as night background. Roy attempted a 'recovery from unusual positions manoeuvre', which had been part of normal instrument training throughout his 12 years of flying, but the nose had progressed too low and the speed had built up to a point where the aircraft was unrecoverable. Despite his continuing efforts, '965 was by this time passing through 30,000ft, so Roy directed John to eject. On leaving the aircraft, the RSO was hit by the full force of a Mach 1.4 slipstream, from which he suffered severe strains and descended at a very high speed. Roy continued his fight and just before he pulled his between-the-knees bailout ring, he heard the warning horn blow, indicating that '965 was now below 10,000ft (with the landing gear up). The SR-71 hit the ground like a hypervelocity meteorite in a near vertical dive and was totally destroyed. The crash occurred in a remote, isolated area of Nevada at approximately 7:20pm – there were no witnesses at or near the scene of the accident, but reports soon came in from Oakland Center and Lovelock that an aircraft had crashed.

ST. MARTIN/CARNOCHAN

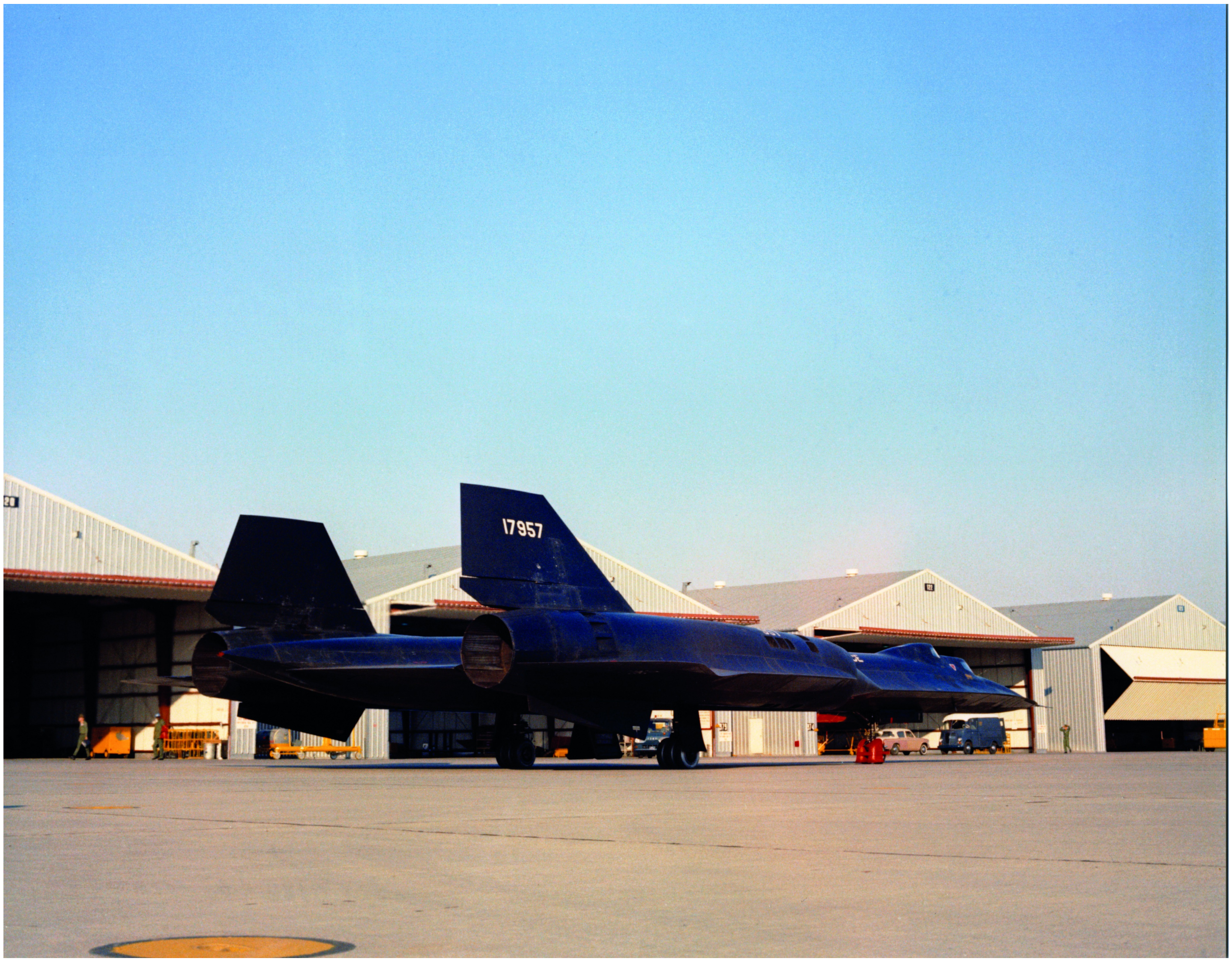
Major Roy St Martin and his RSO, Captain John Carnochan, ejected safely from '965 following an INS platform failure on the night of 25 October 1967. (USAF)

Both crewmembers survived without permanent injury, although John was grounded for a year as a result of severe concussion. Roy remembered walking for what seemed like the rest of the night towards the crash site. Meanwhile, Beale's formal dinner had been disrupted with the discovery that Roy and John were missing somewhere over Nevada. A search effort was quickly mounted and the crew recovered at first light.

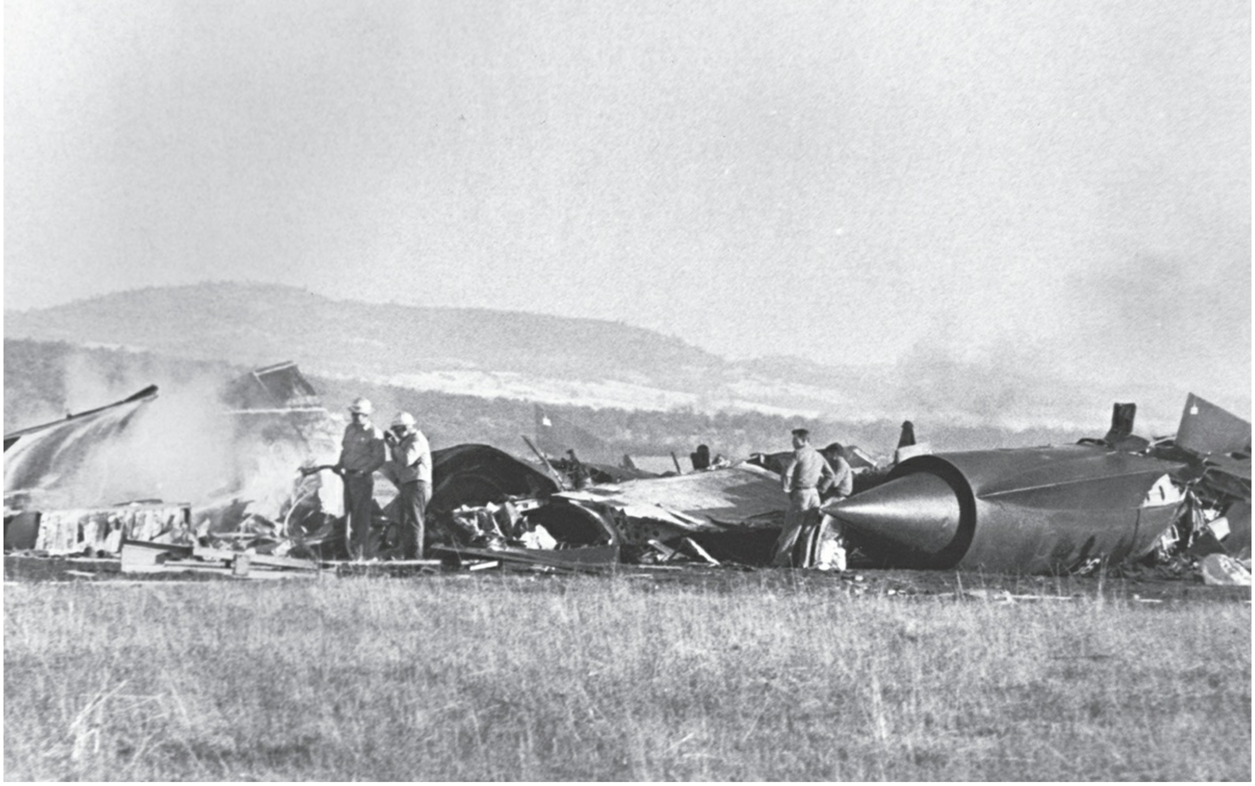
POST SCRIPT

The accident board established that pilot error was not a factor in the loss of '965, and recommended the following design and procedural changes:

1. Warning lights be provided to show ANS failure;
2. The standby attitude indicator instrument be enlarged and placed atop the pilot's instrument panel directly below the windscreen;
3. The pilot and RSO's attitude instruments be powered by different sources;
4. The training programme contain less night flying until crews had considerably more daytime experience in the SR-71.



The 9th SRW's second SR-71B two-seat pilot trainer, 61-7957, was flown for the first time by Bob Gilliland and Jim Eastham on 18 December 1965. (Lockheed Martin)



'957 came to an untimely end on 11 January 1968, when the crew were forced to eject whilst on approach to Beale at an altitude of just 3,000ft. It then pitched up and impacted the ground inverted. (USAF via Tony Landis)

Aircraft 61-7957, one of the two SR-71B pilot trainers, was lost on 11 January 1968. The student pilot was Capt Dave Fruehauf who was on his third SR-71B flight, having earlier completed a series of practice approaches and go-arounds on his first flight, plus air refuelling and further circuits on his second. This third flight would be his first out to Mach 3. His IP for the sortie was Lt Col 'Gray' Sowers, a highly experienced instructor and commander of the 99th SRS.

The flight had gone well and they were on the return leg to Beale when they experienced a generator failure near Spokane, Washington. This was followed just a few minutes later by a second generator failure. The crew made repeated attempts to reset both generators, which would come online briefly, only to trip again. They declared an emergency and began to decelerate and descend, levelling off at around 20,000ft. Heavy snowfall had closed virtually all possible diversion airfields, so they decided that their best bet was to reach Beale. On an extended straight-in approach, Dave lowered the gear, and as the aircraft continued to descend, recalls:

> We got to about 5 miles out and our deck angle increased as we continued to slow down to our approach speed of about 175kt. All of a sudden we lost an engine, and we just couldn’t get it restarted. Within about 10 seconds the other engine flamed out. Now we’re just gliding and Gray says, ‘Dave, eject’.
>
> Well, I’d come from F-4s and the guy in the back always ejects first to prevent the guy in the front from getting the rocket blast from his seat. So I said ‘Gray, you go’. ‘No, you eject,’ he replied. After I said to him a second time that he should go, he finally got kind of pissed and said ‘Eject, get out!’
>
> By this time we’re slowing down, and starting to get into a stall. So I said, ‘Well, screw you!’ and ejected and he followed. But I’ve always felt a little guilty about that, because my rocket blast impinged on his cockpit.

Both pilots escaped uninjured. The engines had flamed out because the fuel pumps had cavitated due to the aircraft’s angle of approach, interrupting fuel flow to the engines. A subsequent accident enquiry established that the generators had dropped offline as designed when their power output began to fluctuate slightly, as this situation couldn’t be tolerated by the ANS if it was to continue to provide accurate navigational information. As a result of this accident the generator trip parameters were changed, thereby ensuring that they stayed online in similar circumstances; it was felt more important to have an unserviceable ANS than no electrical power.

At the time of the loss of ‘957, Lt Col Robert ‘Gray’ Sowers was the Instructor Pilot (IP) and the 99th SRS commander. (USAF via Tony Landis)

Captain Dave Fruehauf was the pilot undergoing instruction in '957 when it was lost – both crewmembers had a very narrow escape. (USAF via Tony Landis)

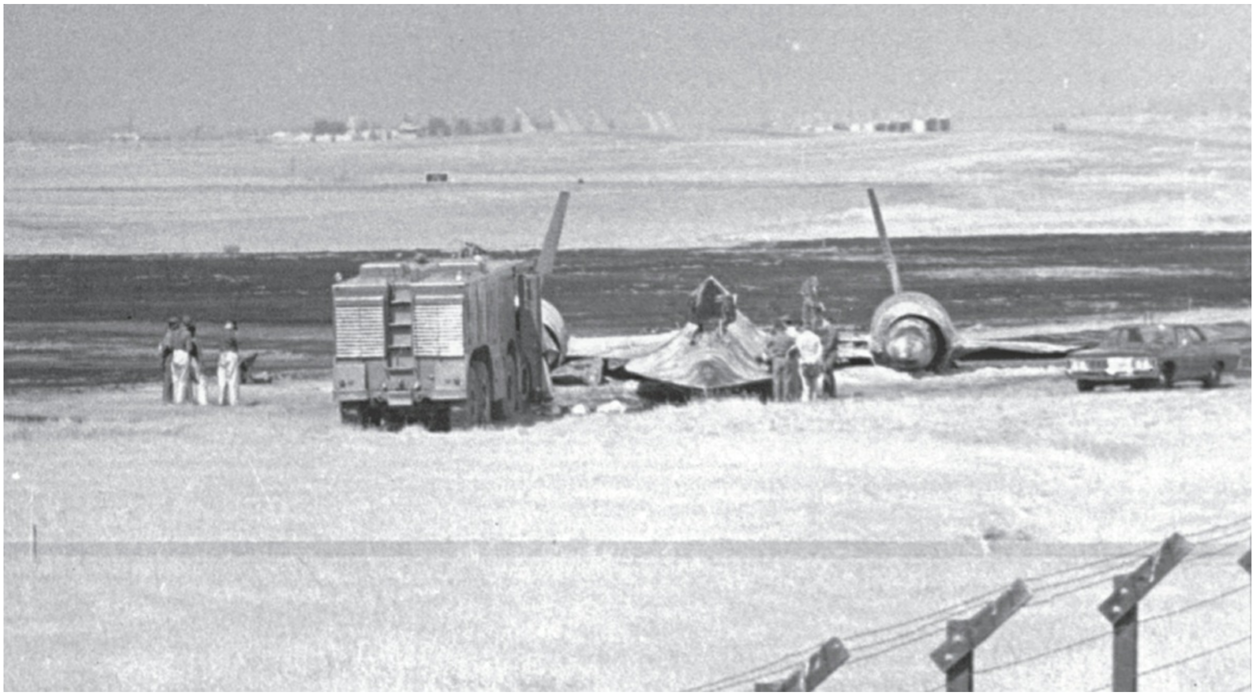
Pictured in relaxed jovial mode, this photo was taken at Beale just prior to the unit's first deployment to OL-8 at Kadena in March 1968. (USAF via Don Walbrecht)

ONE HELLUVA FIRE

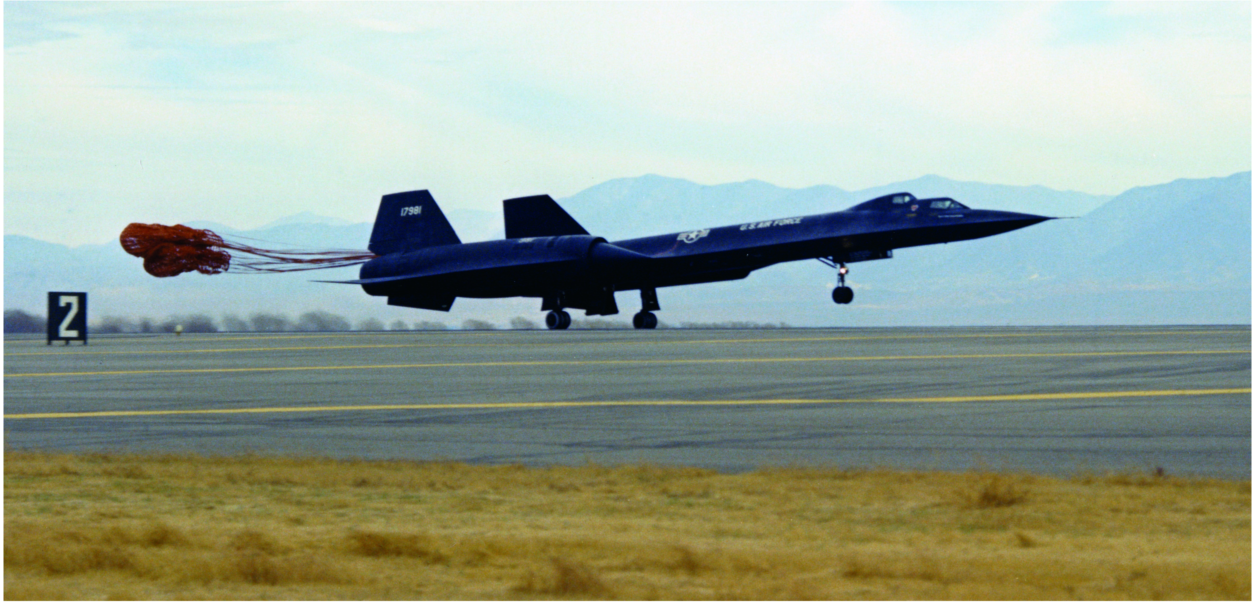
Two months later, Maj Buddy Brown and Capt Dave Jensen were the first of three crews to depart Beale in an SR-71 to cross the Pacific to Okinawa. The 9th SRW's long-awaited deployment to the Vietnam warzone had finally begun. Meanwhile, more new crews were being trained to reach SAC's desired operational strength of two full squadrons.

On 10 October 1968, a new pilot/RSO team began its take-off roll down runway 14 at Beale, in the recently delivered '977. Maj Abe Kardong (a former B-58 pilot) was nearing the take-off Go-No-Go decision point when a wheel failed, throwing shrapnel up into the fuel cell. The afterburner flame ignited the leaking fuel, starting a fire that was catching up with the fast-moving aircraft. The buddy-crew mobile control officers warned Abe that he had 'one helluva fire', whereupon he aborted the take-off at high speed.

At that point the remaining tyres on the affected gear truck also burst; then the brake 'chute blossomed, only to be quickly consumed by fire. Abe steered the aircraft towards the arresting barrier at the far end of the runway. But the jet crossed the rollover sensors (which triggered the arresting cable's pop-up) off-centre and with one wing low, the cable snapped up in front of an inlet, whose sharp edge instantly knifed through it.



Beale lost its third SR-71A, ‘977, following a wheel failure on take-off on 10 October 1968. The aircraft was written off in the accident. (Appeal Democrat via Tony Landis)



The loss of ‘957 created the need for another pilot trainer when ‘956 was undergoing major maintenance. The result was 61-7981, Article 2000, referred to as an SR-71C and nicknamed ‘The Bastard’ due to a lack of formal documentation. It first flew on 14 March 1969. (Lockheed Martin via Tony Landis)

As they proceeded on a very hard ride into the rough, the helpless RSO, Maj Jim Kogler, decided to eject. A few moments later he descended safely under a fully deployed ’chute, which had unfurled a few hundred feet up. For a brief moment he thought that he would drift back into the blazing grass fire that ’977 had caused.

Meanwhile, Abe rode it out for a full half mile before the SR-71 finally ground to a halt, whereupon mobile control crewmembers Willie Lawson and Gil Martinez dashed into the blaze and extricated the pilot from the wreckage. Jim was unhurt, but Abe hobbled around for a few days from spinal compression bruising and other abrasions from his high-speed ride toward Beale’s main gate.

Yet another wheel failure (fortunately the last) had resulted in the loss of an SR-71. Despite four 9th SRW aircraft losses between 13 April 1967 and 10 October 1968, Category III ‘Operational’ Testing ended in December 1968. The 9th SRW was awarded the Presidential Unit Citation for meeting the many great challenges that faced it as it brought the ‘most advanced’ reconnaissance system of its day to operational readiness.

In mid-1966, Bill Skliar left the A-12 programme to become chief of operations for the SR-71 test force at Edwards AFB. On 11 April 1969, Lt Col Skliar and Maj Noel Warner lined up SR-71A 61-7954 on runway 04 at Edwards and began a maximum gross weight take-off. ‘Dutch 60’ had just rotated when one of the left main gear tyres blew. The two remaining tyres were unable to support the aircraft’s weight and burst immediately.

RESCUE
RESCUE

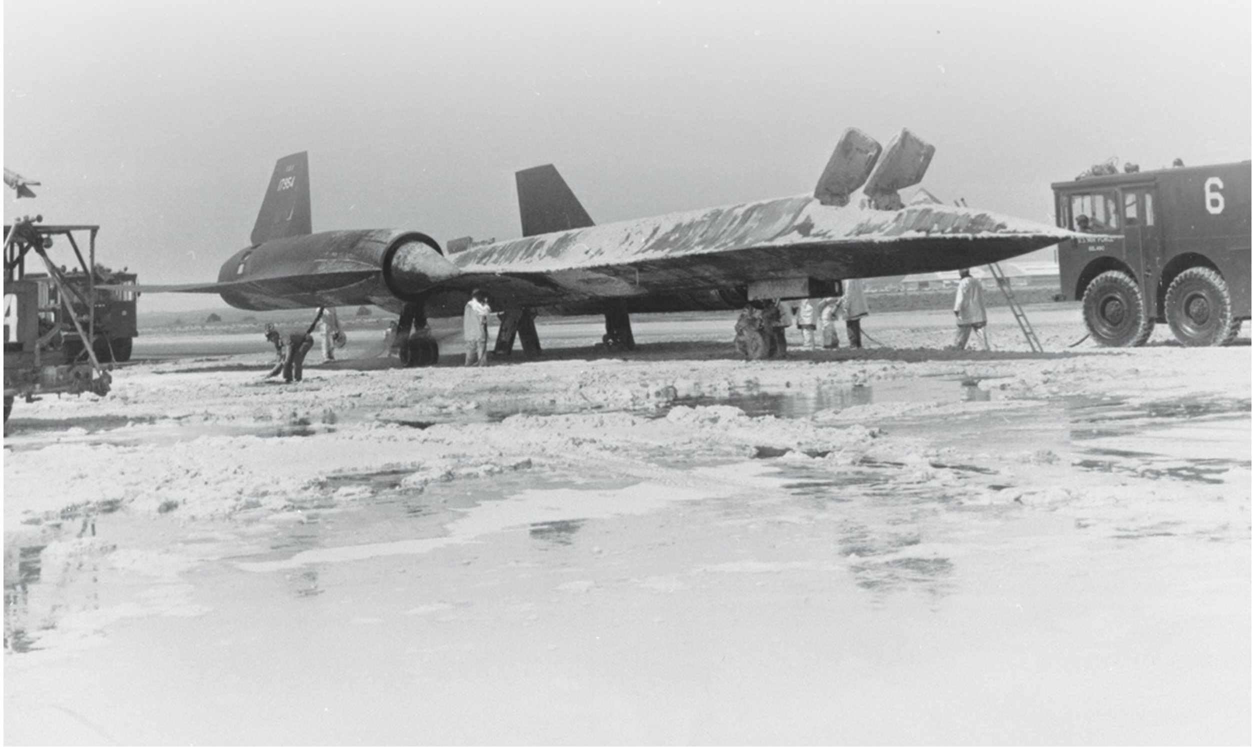
The two crewmembers of ‘977 had a close escape – the RSO Jim Kogler successfully ejected and the pilot Abe Kardong stayed with the aircraft, exiting when it eventually came to a standstill. (USAF via Tony Landis)

U.S. AIR FORCE
954
17954

SR-71As '953, '954 & '955 were all allocated to undertake flight test evaluations by the Air Force at Edwards AFB. '954, first took to the air on 20 July 1965. (USAF via Tony Landis)

On 11 April 1969, Lt Col Bill Skliar and his RSO Lt Col Noel Warner experienced a wheel failure in ‘954 during a max fuel take-off from Edwards AFB. Despite the intense fire both crewmembers escaped unhurt. (USAF via Col Bill Skliar)

Bill aborted the take-off, but the burning shrapnel from the disintegrating magnesium wheel hubs caused a fire that rapidly engulfed the aircraft. He managed to retain control and halt on the runway. The worst of the fire was along the left side because a breeze kept the right side relatively clear; Skliar exited to the right and then assisted Warner from the rear cockpit as the fire began to billow around them. Both crewmembers survived, but ’954 never flew again. After the incident, all SR-71 wheels were replaced with less combustible aluminium units, and B. F. Goodrich beefed up the high-speed, 239kt-rated tyres.



Despite managing to keep the aircraft on the runway and prompt action from fire crews, ‘954 was written off. (USAF via Tony Landis).

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Lt Col Joe Rogers and Lt Col Gary Heidlebauch both ejected safely from ’953 before it crashed near

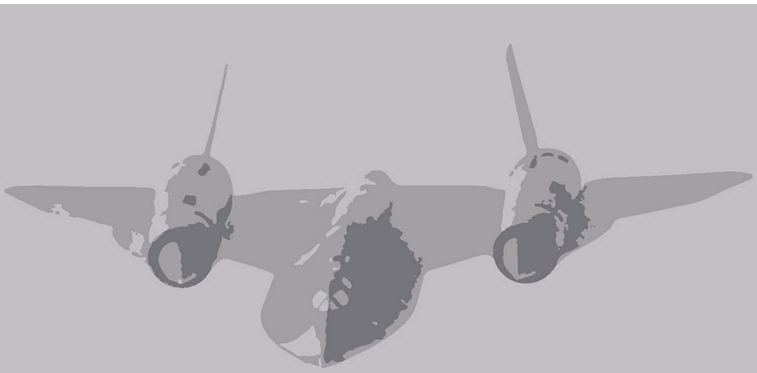
Shoshone, California on 18 December 1969. (USAF via Tony Landis)

PITCH-UP ACCIDENT

On 18 December 1969, Director of the Test Force Lt Col Joe Rogers (an experienced test pilot with more than 200 hours on the SR-71) and RSO Lt Col Gary Heidlebauch were scheduled to fly 61-7953 on a routine test sortie. The aircraft had been undergoing extensive modifications to install a new ECM system, and this would be its first flight for many weeks. After air refuelling, Rogers initiated a pre-planned acceleration and climb. Soon after transitioning to supersonic flight, 'Dutch 68' experienced an explosion, accompanied by a loss of power and severe control difficulties.

As the aircraft decelerated, its angle of attack continued to increase despite Joe pushing the control stick 'hard against the firewall'. After slowing to subsonic speed, the wholly fuelled aircraft became increasingly less controllable and both crew realized '953 had entered an irrecoverable corner of the flight envelope. Ten seconds after the explosion, Rogers knew it was time to go and ordered, 'Let's get out, Gary!' Both men safely ejected, while the aircraft (in a deep stall) pitched up. Soon after, '953 made its crater-grave near the southern end of Death Valley. The cause of the explosion remains unknown.

61-7953 was the second Air Force flight test aircraft to be lost in an accident. (Lockheed Martin)



CHAPTER 11:
AFLC, MAINTENANCE, MISHAPS AND RECOVERIES

17955
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‘955 was the dedicated SR-71 test vehicle that joined Det 51/Det in January 1971 with 598 hrs on the airframe. (Lockheed Martin via Tony Landis)

AIR FORCE LOGISTICS COMMAND

Plant 42 at Palmdale was used as the SR-71's acceptance test centre. It was here that an Advanced Systems Project Office (ASPO) was established. Each new SR-71 was subjected to a series of extensive Functional Check Flights (FCFs), before being delivered to Beale by a 9th SRW crew. On 31 December 1970, the functions of this unit were transferred from Air Force Systems Command (AFSC) to Air Force Logistics Command (AFLC), and Det 51 of AFLC was created. The unit reported to the Sacramento Air Logistics Center and had subdivision offices at Norton AFB, San Bernardino, California which was conveniently located near many of the contractors and subcontractors.

The function of the ASPO was to provide total logistics support to the SR-71 programme, including maintenance support (spares, major overhauls, and testing and evaluation of new or upgraded systems). A September 1977 reorganization placed the duties of Det 51 at Plant 42 in the hands of Det 6. Command of this new detachment was at Norton AFB, with further lines of command to Wright-Patterson AFB in Ohio.

Virtually all aspects of the SR-71's mechanical and sensor systems were modified and updated during the course of the Senior Crown programme. At any one time, contemporary and advanced technology systems and capabilities were fielded that encompassed all airframe, engine, subsystems and sensor/defensive systems that would ultimately be incorporated on upgraded operational aircraft. Two flight test crews were assigned to Det 51/6 Flight Test Division at any one time and they were responsible for conducting extensive FCFs on dedicated flight-test SR-71s based at Palmdale. In addition, these crews also completed FCFs on recently overhauled operational aircraft before they were returned to Beale.

Significant programmes tested at Palmdale included high-Mach/high-bank angle envelope clearance, a high-Alpha (angle of attack) warning and protection system, DAFICS, electrical system replacement, stability system improvements and advanced sensor and defensive system qualification. Literally everything from nuts and bolts to newly manufactured and uprated engines were all extensively tested. The dedicated flight test crews (one crew selected from the

USAF Test Pilot School, the other coming from the operational fleet) flew between 150 to 200 hours a year, and were supported by Lockheed ADP maintenance and engineering personnel from 1970 to 1990.

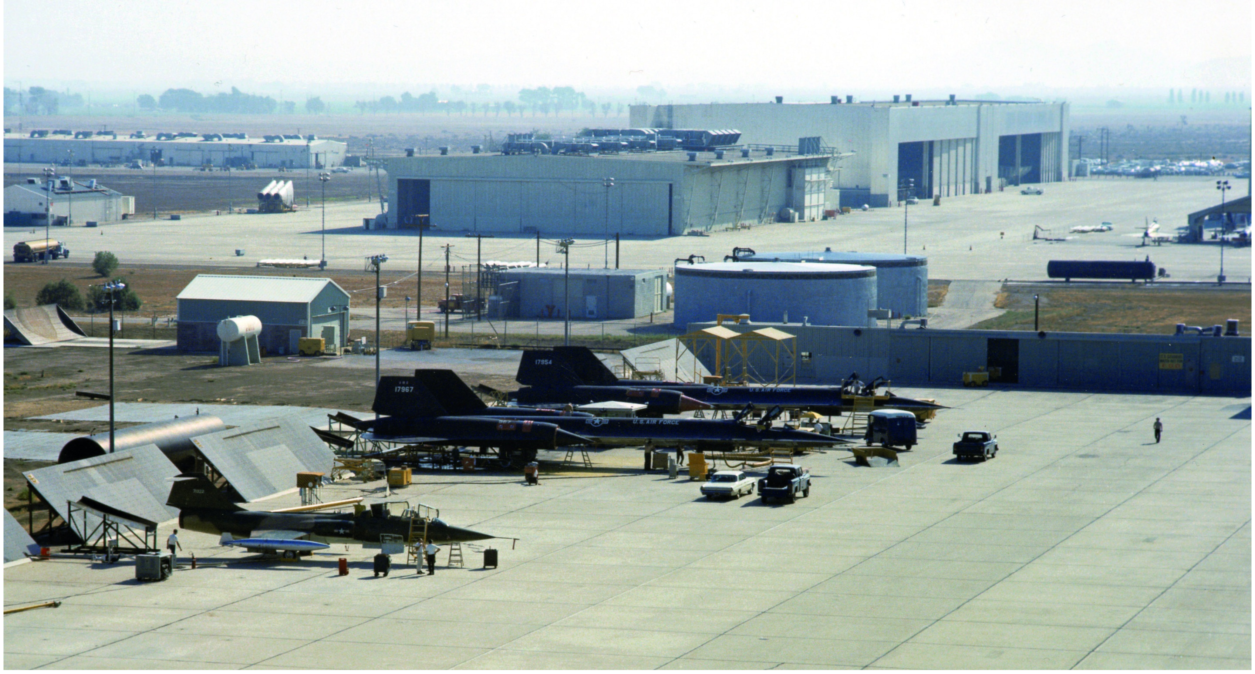
BIG TAIL

To remain ahead of Soviet missile development, the Air Force contacted Lockheed engineers requesting the development of an aft-directed ECM system to be used against advanced missiles (note the outline history and flight testing of SR-71 ECM systems in Chapter 9, under the sub-heading DEF Systems). Additional fuselage space was necessary to accommodate the real-time data transmitters. Design consideration was given to equipment pods and conformal packages, however, an extended tail became the favoured option. This modification considerably increased capacity whilst requiring minimum airframe and systems modifications. Additionally, it produced low aerodynamic drag and was relatively cheap. After the Air Force accepted the new design, '959 was transformed into the 'Big Tail' SR-71.

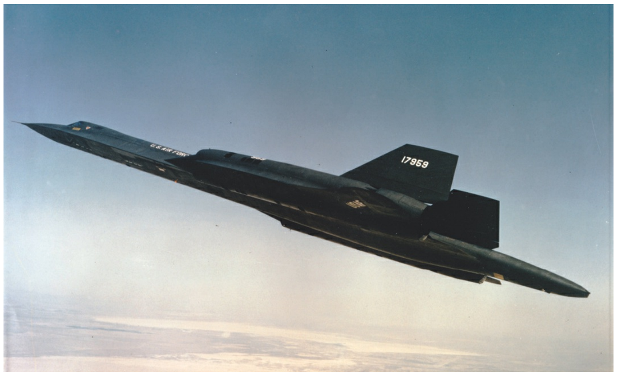
Flight testing began on 20 November 1975, when Lockheed test crew Darrell Greenamyer and Steve Belgeau conducted high-speed taxi tests. The new tail unit was almost 9ft long, weighed 1,273lb, added 49 cubic feet of extra capacity and could carry a maximum payload of 864lb. To prevent it from contacting the ground during the take-off rotation and to keep the drag 'chute from fouling it on landing, the tail was hydraulically repositioned 8½° up or down.

A second test was conducted by the same crew on 11 December. During this first airborne test, Greenamyer accelerated to Mach 1.27 so engineers could evaluate the stresses on the extended fuselage section. Eleven flights later, Lockheed handed Big Tail over to Det 51 at Palmdale. On 5 May 1976, Lt Col Tom Pugh and Maj John Carnochan chalked up the first Air Force test flight in the aircraft. On that sortie '959 was equipped with DEF J and an optical bar camera nose section.

The test series included a Mach 3.0 flight on 4 August, after which the Air Force test crew certified the modification as 'having no detrimental effects on the aeroplane's handling characteristics, or its maximum Mach, while considerably enhancing the SR-71's overall mission capabilities.' To further demonstrate its enhanced mission capabilities, Big Tail was flown with two OBCs; one in the nose and one in the tail. Later the chine bays were deepened to accommodate two further OBCs in each. It was later found that the intercept capabilities of the SA-5 were less of a threat to the SR-71 than had been anticipated, and it was determined that the fleet would not require the Big Tail mod for an aft-facing ECM suite. With the test series complete, Lt Col Pugh and Maj Bill Frazier crewed the unique aircraft on its final Det 51 flight on 24 October 1976, after which it was placed in storage.

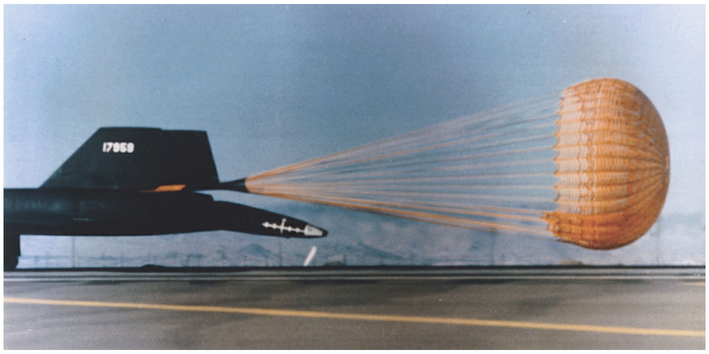


‘967 and ‘964 are pictured at Palmdale whilst rotating through on Programmed Depot Maintenance (PDM). The camouflaged F-104, another of Kelly Johnson’s masterpieces, dates the image. (USAF)



The most striking modification made to an SR-71 from the operational fleet was that applied to 61-7959.

Known as ‘Big Tail’, the 8ft 10in. extension was added to house additional sensors and ECM equipment. (Lockheed Martin)



To prevent the extended tail from ground contact during rotation, or the brake ‘chute from fouling during landing, the tail was hydraulically repositioned 8° 30in. up or down. (USAF)

THE BLUE STREAK TEAM

Another maintenance resource available to the SR-71 programme was the Lockheed Blue Streak Team. They were used to perform depot level work in the field that was beyond the USAF’s capability. In the very early days, they were sent to Beale to do critical modifications that couldn’t wait until the aircraft returned to Palmdale. The first incident requiring the deployment of the team overseas began at Kadena on 24 September 1974, when Capt Maury Rosenberg and his RSO Capt Don Bulloch climbed away at 10:15am in 61-7976 as Maury explained:

> There was a requirement for a double engine change and there was only one engine on station that had been inspected, plus the recent arrival of a couple of new engines. There was an urgency to get the Functional Check Flight completed as soon as possible, so the on-site engine together with one of the new engines were installed, without the latter first undergoing the usual on-site inspection.
>
> I took the aircraft out to max speed 3.2 Mach, and as I retarded the throttles to slow to Mach 3.0, we had an un-start on the right-side, followed almost immediately by a fire light. A check through the periscope confirmed we had a fire in our right engine. I initiated an emergency descent and we worked through the engine fire shut-down checklist. We were in a supersonic descent and the ‘battering’ we got in the cockpit was extreme, making it difficult to read the instruments. Then the left engine flamed-out and the generator tripped off-line. I pushed-up power on the left throttle, but there was no instrument movement i.e. RPM, EGT. We lost cabin pressurisation, so our pressure suits started inflating, making movement more difficult. I pulled my tie-down strap down, to keep my suit helmet from rising higher, and we worked through the engine inflight re-light checklist. There was a moment when I pushed the nose forward (45+°down), to increase our descent and increase airflow to the left

engine, when all I could see was the ocean getting bigger through my windscreen and I thought, 'If this baby doesn't re-light we're going to have eject pretty soon.'

Captains Maury Rosenberg (right) and Don Bulloch suffered an engine fire onboard '976 whilst deployed to Kadena on 24 September 1974. An engine maintenance issue was identified as the problem and a Blue Streak Team was deployed from Palmdale to fix it. (USAF)

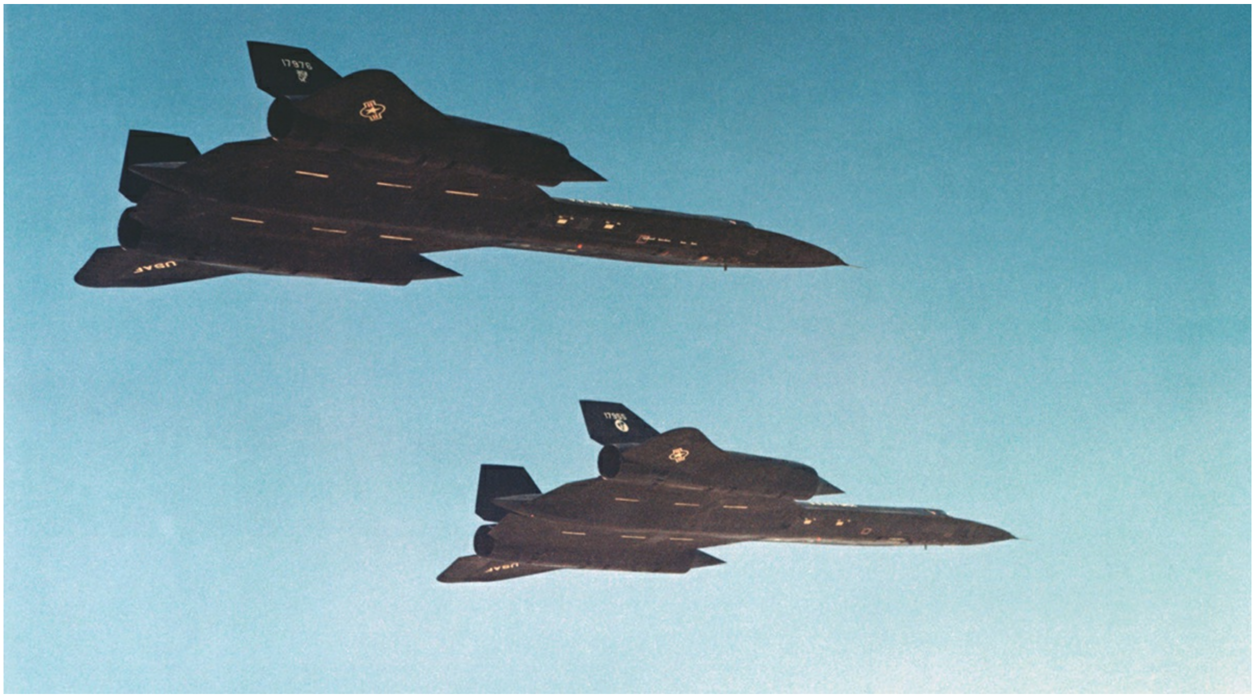
'975 was used by Det 51 from 25 October 1979 until 23 April 1980 to evaluate DEF A2. (USAF via Tony Landis)

We managed to re-start the engine, but due to our gross weight, our single engine cruise altitude was only 11,000ft. Don did a great job keeping up with the checklists, and resetting our inertial

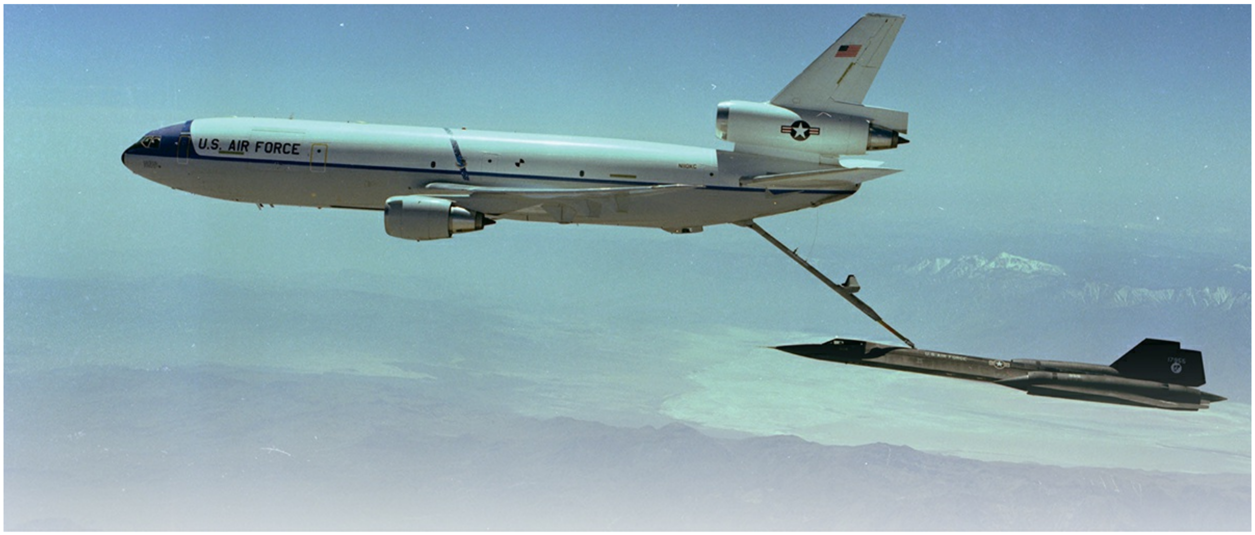
> navigation platform, so as to have reliable navigation and heading information – there was a brief time when we were flying the horizon and whiskey compass only. Once established at single engine cruise speed, the return and single engine landing at Kadena was uneventful.
>
> When the ground crew looked around the airplane chief Fraser saw holes in the nacelle and he approached me after I had gotten out of the aircraft while still in my pressure suit and wanted to know what the heck I'd done to his airplane. I changed into my flight suit and went back out to the aircraft just as the technicians were opening the nacelle. It looked like a slot machine that had just hit the jackpot, as parts and pieces fell out everywhere. The new arrival engines were inspected and the keepers that held the turbine blades in position were missing. It was assumed that when I had the unstart, it went through its normal cycle and the blades were thrown forward with the spike. They were then sucked back in, as the inlet tried to recover, and as a result, shelled the rest of the turbine.

In recognition of their actions, the crew received a 'Well Done Award, for Outstanding Airmanship and Professional Performance During a Hazardous Situation and for a Significant Contribution to the USAF Accident Prevention Programme.' It says a lot about the exceptional nature of the HABUs, that just three days after the incident, Maury and Don climbed into '963 and completed an operational mission lasting 4.3 hours.

The Blue Streak Team that deployed to Kadena comprised personnel from the Depot at Site 2, Palmdale and were chosen for their particular expertise. The damage sustained by '976 was considerable and it wasn't until 10 January 1975 – some 14 weeks later – that Lt Col Tom Pugh and Maj John Carnochan from AFLC Det 51 flew the aircraft on the first of five FCFs before ferrying the aircraft back to the States on the 30 January 1975.



On 16 May 1975, DEF J installed in '955 participated in a test sortie where '976 flew as the target and a head-on crossover was made. Completion of the test sortie provided a rare photo opportunity for two Habus to fly in formation. '955's log notes that DEF J failed to see '976. (Lockheed Martin via Tony Landis)



KC-10/SR-71 compatibility trials were first flown on 17 March 1983 by Tom Tilden and Joe Vida. (Lockheed Martin via Tony Landis)

A DET 6 PILOT'S INSIGHT

By the early 1980s the SR-71 programme had clocked up hundreds of operational missions and tens of thousands of flight hours. After over 20 years of flight testing, one might reasonably ask what more was there to test? The short answer is plenty, an Advanced Synthetic Aperture Radar System improvements for more night missions including a laser horizon, improved electronic countermeasures, and a stream of improvements in all areas from the pressure suit to the electrical system. As Lt Col Tom Tilden eloquently explains:

> The most significant development for me as a test pilot was DAFICS, the Digital Automatic Flight and Inlet Control System. DAFICS featured three Honeywell digital computers that replaced the original analog control of flight control stability augmentation, autopilot, air data, inlet control, and stall warning. DAFICS was the Logistics Command solution for problems supporting outdated and hard-to-maintain analog systems. DAFICS was designed to duplicate the functions of the analog systems and add improved self-test and analytical features to enhance maintainability, reliability, and supportability. When I came to Palmdale, Flight Test, including my predecessor test pilot Cal Jewett, had completed initial development of DAFICS and it was being installed in the first operational aircraft. Bob Helt was the other Flight Test pilot and my instructor to learn the SR-71. Bob was also programming DAFICS logic into the SR-71 simulator in Boolean algebra, much to the amazement of both me and the Singer-Link simulator support team at Beale.
>
> DAFICS presented opportunities never before available to Flight Test. Here were digital computers that interfaced with everything: autopilot, stability augmentation, inlet control, air data. There would be software improvements to DAFICS as we gained experience in the operational fleet, particularly on the maintenance side. If I came up with an idea, it could often be implemented with a software change at little cost on a ride-along basis with software updates for maintenance.
>
> Think of the possibilities. Before, if you wanted to add a simple switch in the cockpit or change an analog system, it may have cost hundreds of thousands of dollars for new blueprints, parts, installation, updates to every pilot and maintenance schematic and manual, and more. Now, a DAFICS software change, such as improving how inlets reset after a temporary loss of power, did not require any parts, diagrams or manuals at the operational level.
>
> I thought of several ways to improve the SR-71 that only required software changes. For example, a change that finally made Mach Hold a useable autopilot mode. Working with the concurrence of programmers at Honeywell and Roger Nelson of Lockheed these ideas went from concept to reality. A test pilot is both a pilot and an engineer. What can be more exciting for a test pilot than not only flying one of the finest machines ever invented but also improving that aircraft?

Between 16 May 1980 and 21 January 1981, '974 was used by Det 6 to undertake trials to evaluate DEF H and flying practice profiles for tracking the first Space Shuttle flight. (Lockheed Martin via Tony Landis)

The most characteristic SR-71 problem was unstart. Unstart is not an engine problem, it is an inlet problem. Unstart may, and often does, affect the engine, but usually the engine continues to run. The SR-71 positions shocks inside the inlet ('starts' the inlet) to produce the highest possible pressure in the subsonic air behind the last shock wave. High pressure improves power and fuel efficiency. However, if the pressure gets too high, the inlet unstarts; the shock wave is violently pushed out the front of the inlet. Theory says that shock waves in the inlet are only controlled by the size of the opening made by the movable spike at the front of the inlet, and the ratio of pressure inside the inlet to air pressure outside the inlet. Inlet position was biased to compensate for air coming in the inlet at a slight offset up and down (angle of attack) or left and right (sideslip).

Over the years I noticed that we frequently had unstarts: at the start of descent from cruise; during climb when we were at light weight with a partial fuel load, but not during climb with a full fuel load; and in cruise if we were flying lower than normal altitude. It occurred to me that all these conditions have one thing in common, they result in lower-than-usual angle of attack.

I had been in discussions with Vic Horton, a NASA Blackbird crew member in the seventies, about NASA tests that might be useful. Vic had given me some NASA test results including a report on small changes in indicated Mach from the air data system when angle of attack changes. We had verified in flight that the Mach number on our instruments went up slightly with higher angles (nose up) and went down slightly at lower angles.

I decided we should change the spike bias for angle of attack slightly to compensate for changes in Mach from the air data system. We would not need to change the pressure ratio and therefore there would be no loss of performance at all. I assumed that designers Kelly Johnson and Ben Rich had missed a subtlety in the inlet schedules. Of course, Kelly and Ben didn't have DAFICS, but Kelly and Ben are two of the finest aeronautical engineers ever. We should be careful tinkering with success. By that time, BC Thomas had replaced Bob Helt at Flight Test. BC is the high-time SR-71 pilot and a Test Pilot School graduate. BC agreed we should give it a try.

It looked good in theory, but how do we test it? If I had an unstart I did not want to impact the remainder of the test mission by manually controlling the inlet for the rest of the flight.

For 20 years, after a crew had an unstart they were on the edge of their seats for the rest of the flight. If the automatic restart worked, it was not unusual to have another unstart if the conditions had not changed. After flight the crew would notify maintenance. If maintenance did not find a mechanical cause, they would lower the pressure ratio slightly. The adjustment was critical, but so small that the crew could not tell the difference.

AFLC Det 6 Flight Test Team, Palmdale, 1982, from left to right: Mike Relja – Extensive SR-71 maintenance background and knowledge; Bob Helt – pilot, over 1,000 hours in SR-71 and world sustained altitude record holder; Bill Flanagan – navigator graduate of Test Pilot School; Joyce Baker – flight test secretary for Blackbirds, starting as a teenager with YF-12 test; Joe Vida – navigator, high time SR-71 crew member; Tom Tilden – pilot graduate of Test Pilot School; Jerry Annerino – operations specialist. (USAF)

The 1984 Det 6 test team consisted of, from left to right, pilots Tom Tilden, BC Thomas and RSOs Joe 'JT' Vida and Phil Soucy. (USAF)

But why wait for maintenance? DAFICS would detect an unstart and initiate the automatic restart sequence. With a software change, DAFICS could adjust the pressure ratio when it detected an unstart – automatic inflight inlet rescheduling. We programmed DAFICS with the new angle of attack bias and automatic inflight inlet rescheduling. We were ready for flight test.

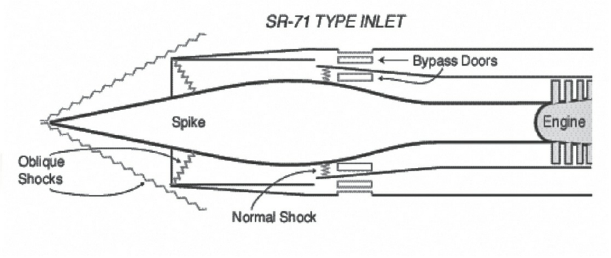
Inlet bias is designed so that the inlet is closer to unstart (higher pressure) at normal angle of attack than with excessive angle of attack or side slip. We needed to show that there were fewer unstarts in normal cruise and no unstarts with greater angles. I called this Russian Roulette. On each flight we increased the pressure ratio very slightly. During cruise at both Mach 3 and Mach 3.2 we would 'roller coaster' between 0.5G and 1.5G and would slowly do a full rudder sideslip left and right. These manoeuvres may sound like small excursions, but they certainly kept our interest. No one at Lockheed could remember if anyone had ever intentionally done full rudder sideslips at Mach 3+. (Full rudder travel at high speed is restricted by the rudder limiter to less than the rudder travel seen at low speed.)

We continued increasing the inlet pressure on each flight. After several flights the pressure ratio was above the range allowed to maintenance and still we did not have an unstart. This gave us confidence that the new correction for angle of attack had not degraded performance at any condition.

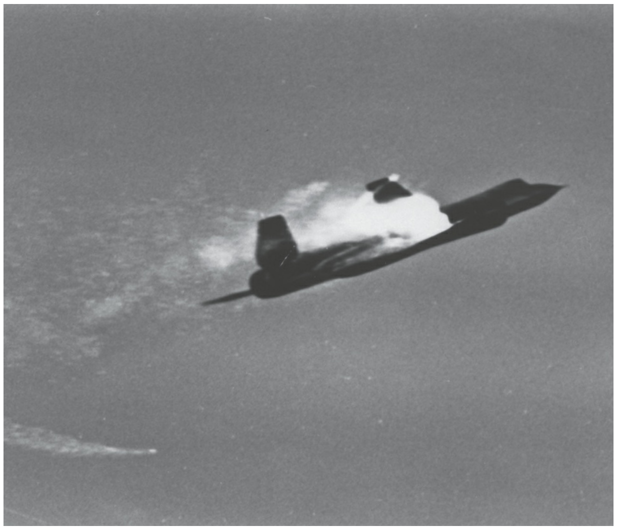
Eventually, we had an unstart. As desired, the unstart was in cruise at normal angle of attack and no sideslip, not at greater angles. After the unstart, the inlets worked normally for the rest of the flight. Automatic inflight inlet rescheduling and the new angle of attack bias worked and were included in the next software change for the fleet.

Over a year later, I was at a meeting at Norton AFB where our parent Air Force Logistics Command unit that supported the SR-71 was based. The meeting was a two-day conference between AF Logistics Command, SR-71 representatives from Beale, and Lockheed.

Late on day two after a big lunch, I was sitting in the back of the room trying to pay attention while a maintenance officer from Beale reviewed maintenance issues from the previous year. Near the end of his presentation he said, 'We had a lot fewer unstarts last year... but these things go in cycles.' I didn't say anything, but it was one of the most satisfying moments in my career as a test pilot.



This diagram illustrates the SR-71's inlet, the area responsible for developing 61 per cent of the total thrust produced at Mach 3. (Lockheed Martin)



The engine fire suffered by ‘960 on 13 May 1980 could easily have resulted in the loss of another HABU. (USAF)

Majors Rick McCrary and his RSO Dave Lawrence congratulate one another having safely recovered ‘960 into Andrews AFB – fire damage to the right nacelle is evident. (Rick McCrary)

The prime test airframe for many years had been ’955, and as a result it was crammed with test instrumentation. In 1985 it was due for its PDM which would have also included repairing and upgrading the test instrumentation. This would have taken an exponential amount of time, resulting in Det 6 being without an instrumented aircraft. It was therefore decided that ’972 would be modified with instrumentation while ’955 was still flying, thereby ensuring that Det 6 had an experimental aircraft at their disposal. So, on 24 January 1985, Lt Col Tom Tilden and Lt Col Bill Flanagan flew ‘ever-reliable’ ’955 on its 722nd and last sortie. Four days later, the same two crewmembers conducted a runway roughness evaluation in the jet and then returned it to the Palmdale storage barn, where it remained for six years. In 1991, ’955 re-emerged for permanent display at the Air Force Flight Test Center Museum at Edwards AFB.

The test flight baton was passed to ’972 when it emerged from PDM and underwent an FCF conducted by BC Thomas and J. T. Vida on 22 January 1985. Its final flight was on 6 March 1990, when Ed Yeilding and J. T. Vida delivered the jet to the Smithsonian National Air and Space Museum following a record-breaking flight across the US. During its time with the division, ’972 accumulated 417.9 flight hours in 163 test sorties.

MAINTENANCE

INCIDENT AT ANDREWS

Another incident calling for the specialist skills of the Blue Streak Team involved 61-7960, and occurred on 13 May 1984, when spectators at the Andrews AFB Open House air show witnessed a spectacular flyby that could have ended in disaster, as Rick McCrary explains:

> The final [SR-71] flight for my RSO Dave Lawrence and I was a ‘good deal’, wherein we would take the Blackbird to Andrews AFB for the DoD air show provided each year to the public. It also had previews for politicians and other VIPs to familiarize them with DoD airpower.
>
> For us it was a wonderful last flight as we already had our follow-on postings to non-flying staff positions. It turned out to be more memorable than anticipated, particularly for Dave’s father and my older brother, neither of whom had ever seen us fly, and who were getting a VIP tour and view of our departure.
>
> As always, this stateside coast to coast flight was a training mission. We would first complete a flyby for an open house at NAS Patuxent River, about 45 miles East and then rendezvous with a KC-10 to refuel for the return home to Beale AFB. The flyby and rendezvous with the KC-10 meant we would not have a buddy tanking, so we were launching with 60,000lb of fuel vs the usual 40,000lb load when going directly to a tanker. The ‘60 load’ is well below the maximum fuel load of 80,000lb used on some missions and not a problem, especially in May on an 11,000ft runway.
>
> Fuel and timing permitted us to make a customary runway pass to salute our maintenance crew who, as always, worked through the night to ensure all was ready for our return flight. Take-off was normal, but as we came back down the runway and engaged afterburner for departure, we received a

call from tower that we were on fire! I quickly looked inside the cockpit and the right firelight was illuminated, which I validated by a quick look through the aft facing periscope, showing we were engulfed in flames. I began a climb to pattern altitude and made a turn away from the base, while Dave and I completed the bold face checklist and confirmed the fire was out. I performed a controllability check and decided to dump fuel and return to Andrews for an immediate landing.

On a wide downwind leg, we stopped dumping fuel before lowering the landing gear and completed the checklist for a single engine landing. As we turned to final approach, I observed significant smoke on the airfield and beyond, indicating that we had been spewing burning titanium and fuel until the engine shut down.

Dave and I verified checklist complete and tower confirmed emergency vehicles were in place for our landing. I maintained the single engine final approach speed of 200kt as per checklist and as practiced on most of our training flights. We also reviewed single engine-go around, which we routinely practiced due to the large engine asymmetry, which demanded full rudder and 20° of bank to maintain heading. We also reviewed landing without drag 'chute, as the potential for damage due to the fire was a concern.

Fortunately, we were able to land as planned and stopped on the runway. Emergency crews arrived and our buddy crew told us to shut down where we were. Our last flight as a crew was a memorable one; made more so by the comments of our relatives who had a front row seat to us exploding in a fireball and then flying out of it!

POST SCRIPT

Mike Relja recalls:

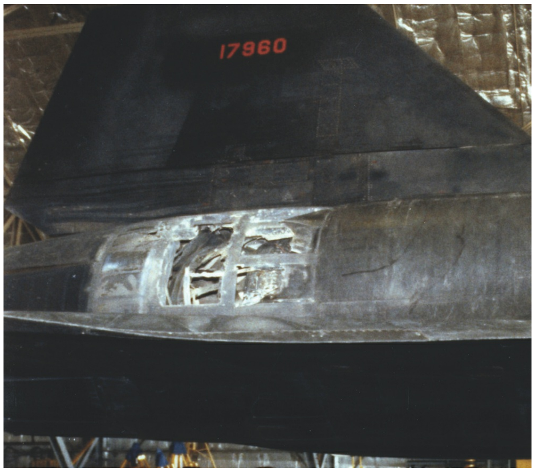
As part of The Blue Streak Team we went to Andrews and spent two weeks there. The team was made up of Lockheed Supervisor Bob Shanonberger, Lockheed Inspector Jesse James, Flight Test Mechanics Al Gatta, Phil Quemada, Artie Ray, and another guy, but unfortunately, his name escapes me. We also took along a Lockheed Tech Writer, since we had to change the outboard right wing and there wasn't a written procedure at that time (even though it had been done before). Beale left a USAF guy, MSgt. Floyd Jones at Andrews AFB too and I was there as the USAF Quality Assurance Rep for Flight Test/Depot Maintenance.

After we arrived, we proceeded to clean up the fire damage, replace the right outboard wing that had been shipped in (it was removed from one of the storage birds and later-on, repaired at Palmdale and replaced). This happened a few times, so some of the aircraft around have a different serial number on the outboard wing to that they were built with, eg 61-7960 and 61-7956 to mention a couple.

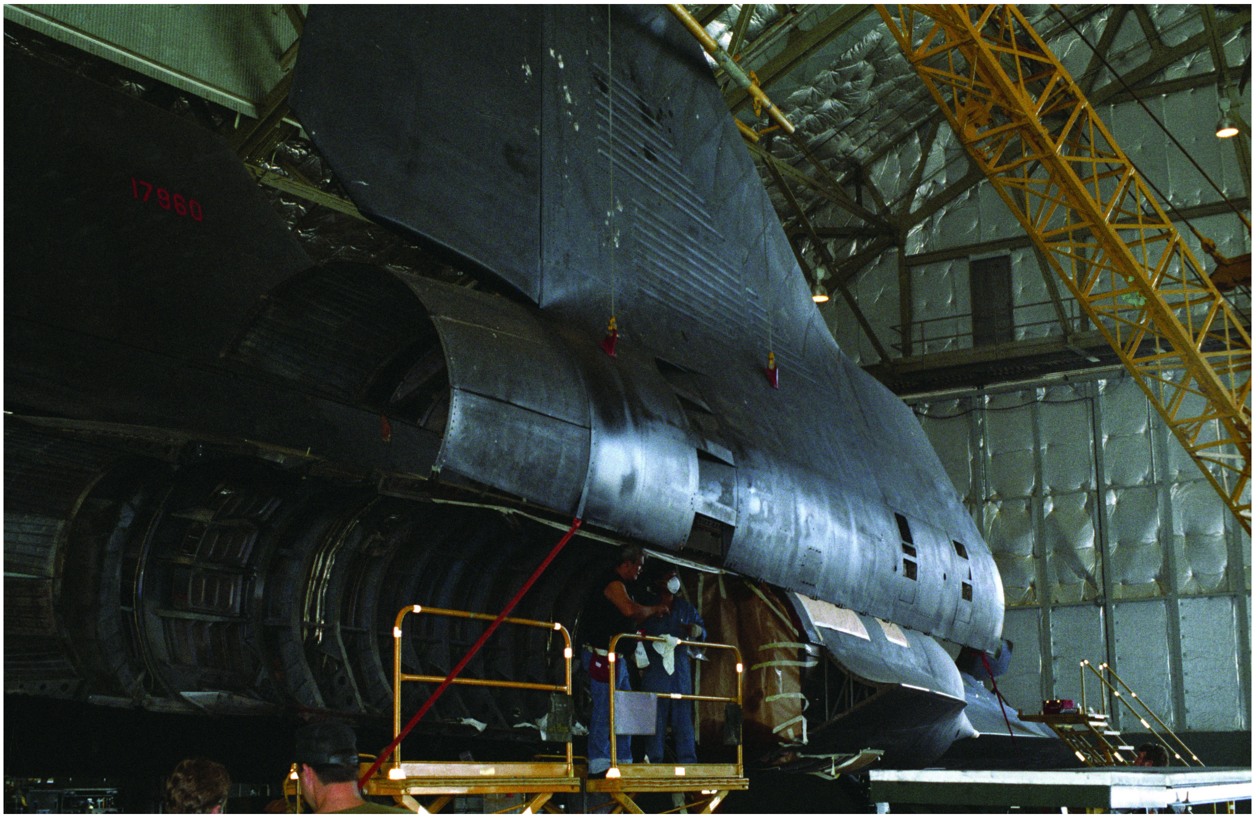
We also had to repair damage to the inboard aft section of the nacelle between nacelle station 1162-1178. There was a hole burned through the top, as well as damage inside the nacelle, that had to have burned parts removed and replaced.

After we'd accomplished our depot level work and the replacement engine was installed, we turned the aircraft back over to SAC and the Beale USAF guys finished getting it ready for a FCF and the return flight home. Usually when this kind of work was going on, the aircraft was turned over to AFLC while we were working on it, and then back over to SAC when we'd finished.

The incident had its beginnings in the right engine's Bird Cage Section that held the engine nozzle actuators in place. Cracks had started forming between the mounting fasteners and someone started 'stop-drilling' the cracks, without notifying the P&W rep. Whoever did this, did not pay attention to how many cracks they'd stopped-drilled and ended up following the crack almost around the circumference of the engine – 54 stop-drills! When '960 departed Andrews for Beale and Rick went into afterburner, the engine nozzle actuators (4 each), started to move the nozzle. That caused the Bird Cage to break loose and forced it outboard, directing the afterburner flame against the outboard wing and nacelle and starting the fire. So when Rick came out of afterburner the fire stopped, but the damage was done. It was pure luck that the Bird Cage Section went outboard, had it have gone inboard towards the fuel tanks…!



A closer look at the damage wrought by fire in the number 2 engine of '960. (USAF)



Once again, the expertise of the Blue Streak Team was called upon and a new outboard wing section was flown in and fitted to '960. (USAF)

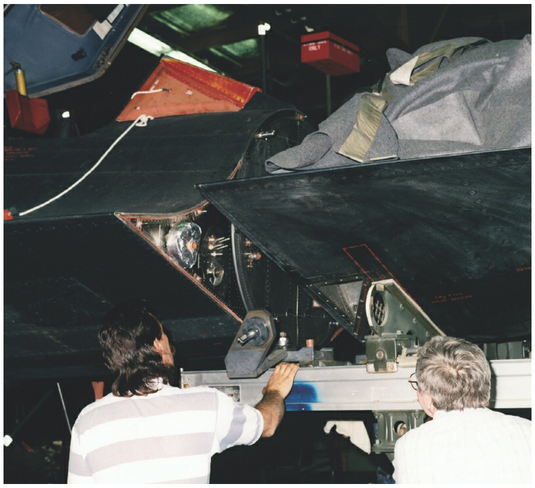
> The aircraft was deemed repairable and Lockheed dug out the original drawings (unique for each airplane), and reconstructed the blown-out area. Maintenance replaced the engine and components, and the airplane returned to Beale three months later…We flew back to Beale commercial with the data recorder in its own seat. The mandatory Flight Evaluation Board determined that I was not responsible for the incident.

MAINTENANCE AND UPSETS

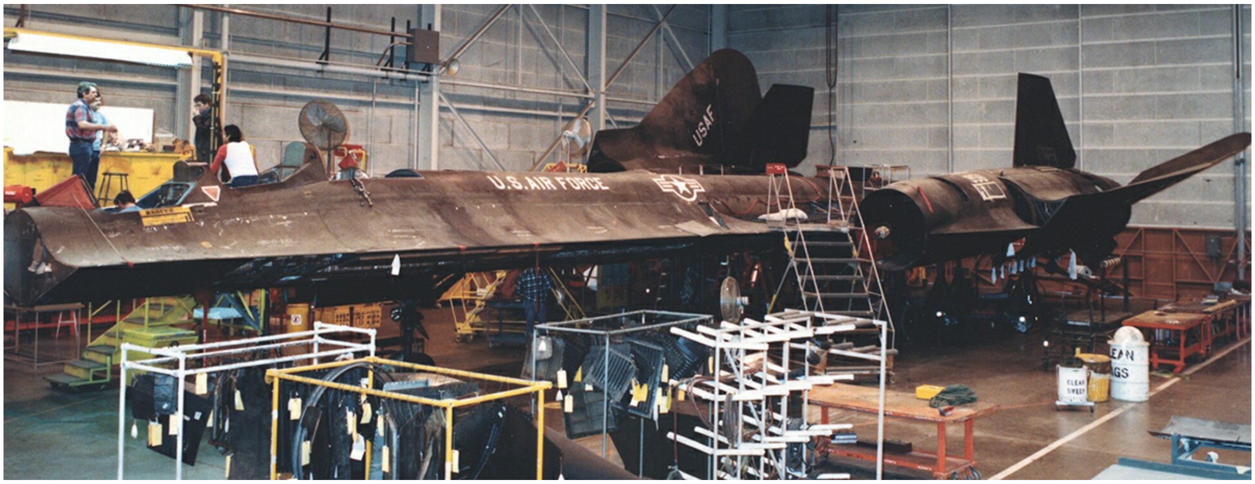
As we've seen, the SR-71 was unique, each one was hand-built so no two were the same, as a result each had its own idiosyncrasies. The aircraft cruised in the top right corner of the flight envelope in order to execute its mission. Its flight environment was punishing on the airframe and all its components. During 54,000 flying hours, accumulated during 17,000 sorties, including 3,500 operational missions, the demands made upon those who maintained and supported this extremely complex aircraft were immense. It is therefore important to examine what it took to 'keep 'em flyin'' against a background of the aircraft's extremely impressive accomplishments.

Former SR-71 maintainer and manager Mike Relja gives us some of his insights:

> I was the Crew Chief for SR-71B 61-7956 at the time of this incident. It was the third check flight for Jay Murphy and his Instructor Pilot (IP) was Pat Bledsole. I had launched the aircraft in the morning and it was coming back in the early afternoon. When they got back in the Beale area, they started a simulated single engine-out pass from the south-end of the runway.
>
> Jay Murphy, being the student would have been in control, putting the left (#1) engine in idle and going into afterburner (AB) on the right (#2) engine, while applying full right rudder to steer into the good engine.
>
> I was watching the aircraft from behind the B Model shelter (#115) and as Jay carried out the manoeuvre, the right aft outboard wing burst into flames. I assume at this stage the IP Pat Bledsole took over and he quickly brought the right (#2) engine out of AB and brought the throttle up on the left (#1) engine. When he did this, the fire went out on the right outboard wing. The first thing that crossed my mind was whether I had done something wrong during maintenance or missed something on the pre-flight inspection. I grabbed the tow bar and tow vehicle (Yuke), and headed for the runway with the Fire Department, since I knew he would declare an emergency and shutdown on the taxiway once he had landed. He flew the pattern to the right and then landed on the runway from the south. He pulled off the runway at the center cross taxiway and shutdown. The Fire Department and I went to the aft right side of the outboard wing and saw several holes burned in the underside of the wing and ventral fin, but no fire was visible.

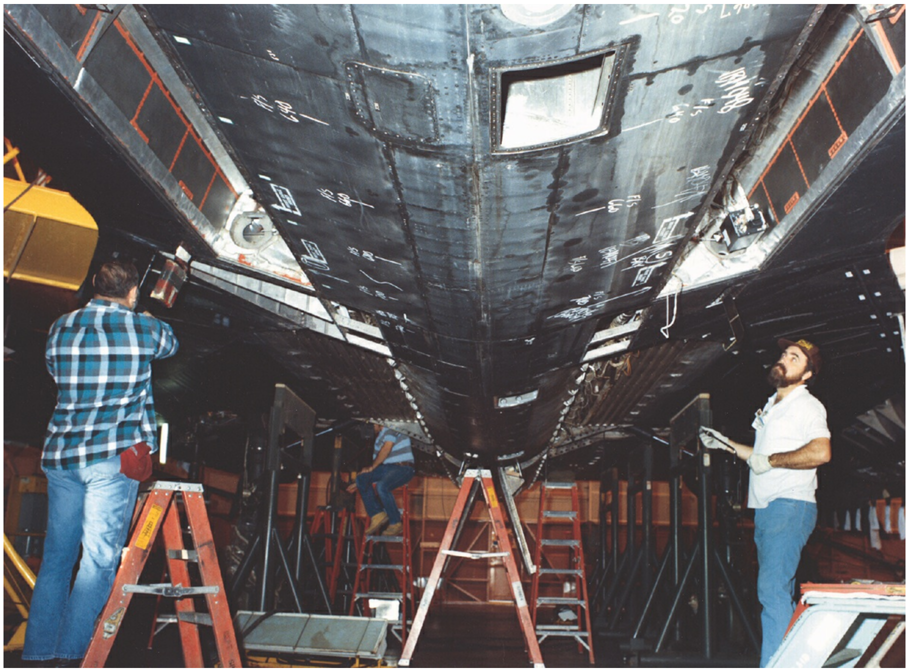


Maintenance technicians remove the nose section of 61-7956 during PDM at Palmdale. (Mike Relja)



A PDM for '956 progresses as the engines and inlet spikes are removed, together with the upper wing surfaces, ANS, canopies, ejection seats and nose section. (Mike Relja)

I told the Fire Department we were okay, but they had other problems. While #956 flew the landing pattern, hot melted titanium had fallen to the ground, igniting grass fires in several places around the base – including the fuel pumping station! I looked inside the aft part of the right engine and the AB liner had a long-torched section that looked like someone had taken a cutting torch to it.



Technicians work on '956's under surfaces. Note the two empty equipment bays (T and S) in the forward fuselage. In the SR-71A each of these would have housed a TEOC, or DEF H in the right bay (T) and a TEOC in S-bay. Also note the chalk marks at the various fuselage stations. (Mike Relja)

POST SCRIPT

After the engine was removed and inspected, it was discovered (much to my relief) that a Compressor Bypass Transition Duct Assembly, which takes 4th stage compressor air and bypasses the rest of the compressor and hot section and dumps that air into the turbine section, had one of the forward internal guide vanes break loose. In probably a million to one shot, it had made it through the duct and lodged in the turbine section, disrupting the cooling air and making a hot spot that torched its way through the AB liner.

When the crew went into AB on the right engine, the flame was no longer contained in the AB section, and it set the right outboard wing on fire until they came out of AB. Later, a Service Bulletin (SB 490) Jan 75, Compressor Bypass Transition Duct Assembly Inspection was issued to inspect all the spare and installed engines for the same defect.

Then in March 1975, another Service Bulletin (SB 492), Compressor Bypass Transition Duct Assembly Stiffening Rods, was incorporated in all the engines, to prevent this defect from happening again.

An outboard right wing was taken from one of the storage aircraft and installed on ’956. Luckily a ventral fin was found in stock and installed to repair the damage sustained on the aircraft.

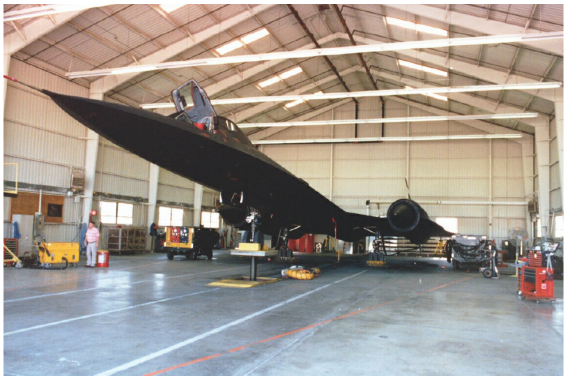
Years later I was talking to Pat Bledsole about the incident and he told me that the accident investigation board had given him ‘static’ as the IP, as he hadn’t ordered an ejection from the burning aircraft. I asked why, as I’d seen the fire go out as soon as he’d come out of AB. He said that’s what the tower said too. But he got the static from the board anyway. But it was through his actions that Pat had saved the only remaining B Model we had which went on to fly until 1999.

Mike Relja continues:

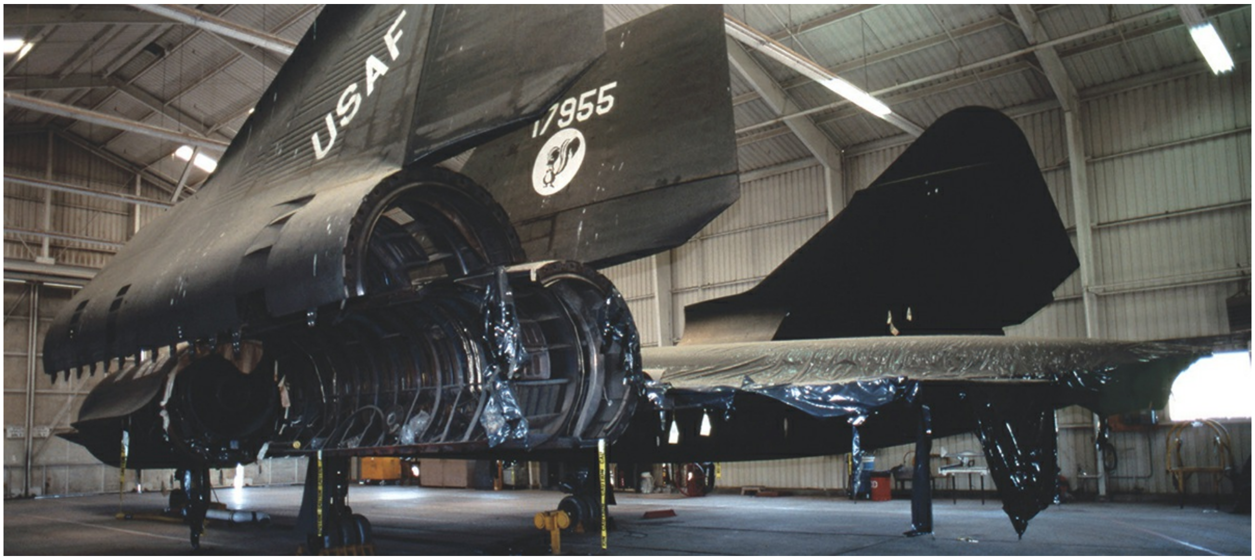
After several TDYs to DET 1 as a crew chief, I returned to Kadena on the first Permanent Change of Station (PCS) package in 1976 to 1980, and spent all that time in Maintenance Control and ended up being the NCOIC of Maintenance Control at DET1.

We would get the next month’s proposed Operational Flights (called Hard Missions) the month before in a classified message from the Strategic Reconnaissance Center at SAC HQ. It would give us the proposed flight days spread out over the up-coming month by day flights and night flights. I would put little black tick marks for daytime flights and red tick marks for night flights on my desk calendar so I wouldn’t have to go to the safe all the time for the message, only I knew what those little marks meant. Other Operational Flights could be added depending upon world/area situations prevailing at the time. This was done via Secure Voice telephones in Flight Operations during normal daytime operations or Maintenance Control after normal hours (Maintenance Control was manned 24/7/365). Maintenance flights could be added as needed depending on the aircraft maintenance.

Actual tasking would come in the day before the scheduled flight day from Flight Operations/Mission Planning. It would show the tail number, required sensor load, fuel load, take-off time and duration, crew names, etc. If two aircraft were required for a particular mission, we’d generate two aircraft at the same time (called a Hard and a Backup). Sometimes the sensor configurations were the same for both aircraft, on other occasions one might require a Radar nose and the other a Photo nose, depending on weather conditions expected over the denied area.



With '956's PDM almost complete, the aircraft is pictured in the fuel barn. Here hoses were connected to the Y manifolds where the engines would be hooked up if they were installed. The aircraft was then fuelled full (80,000lb of JP-7) and the complete flight envelope simulated, checking tank sequencing. With the tests done, the fuel was pumped back into underground storage tanks. The hydraulic lift raised the aircraft's nose wheel leg, putting the aircraft in a 7° nose-high attitude to simulate flight at Mach 3+. (Mike Relja)



Having accumulated 1,993.5 hours, '955 was towed into retirement at Palmdale having undertaken its final flight on 28 January 1985. (Lockheed Martin)

Maintenance sensor shops would start their preparations in their shops, while the crew chief and his maintenance crew would start prepping the aircraft. One of the first things accomplished would be a Pre-launch Operational Check (PLOC) engine run on the selected aircraft. The crew chief and his crew would do the run in the hangar, checking everything that could be accomplished at that power setting, (idle to engine fuel de-rich check). Hydraulics, generators, fuel boost pumps, flight controls, steering/brakes, engines were all exercised. The run would last around 20 minutes with the MRS tape system operated to allow tapes to be read afterwards for any maintenance items not caught by the crew

> chief during the run. If the aircraft hadn't flown for at least 5 days, we'd do this engine check regardless of the flight schedule. On one occasion I had an ADS/generator fail on one of my PLOC runs and had to accomplish all that maintenance work as well as all the pre-flight, sensor loads, servicing, etc. and we still made the flight the next morning.
>
> After the engine run, if no maintenance items were discovered, the crew chief and his crew would start the inspection phase of the pre-flight. For this the aircraft was broken down into four mechanical areas. Mechanic 1 had the nose, NLG [Nose Landing Gear], NLG wheel well, C Bay, aft fuselage FS 715 to 1355, fuel tanks, drag 'chute, mixer compartments, and forward cockpit. Mechanic 2 had the right/left fuselage chine areas, all the mission bays K/M/P/S/Q/T/L/N/R/E/D, the Aft Cockpit and AC Bay. Mechanic 3 had the Left MLG [Main Landing Gear] and wheel well, left spike and inlet duct, lower left wing, engine, nacelle, upper left wing, engine, nacelle, rudder including rudder stub fin. Mechanic 4 had the right MLG and wheel well, right spike and inlet duct, lower right wing, engine, nacelle, upper right wing, engine, nacelle, rudder including the 'rudder' stub fin.
>
> Several specialist shops also had some pre-flight inspections to accomplish. Electrical installed the aircraft battery and conducted checkouts. The Auto Pilot shop inspected the DAFICS/INS checkout, ANS aligning and loading pre-set destinations, MRS checkout, Photo checkout if carrying cameras, Environmental System checkout, Communication Systems (UHF 1&2, VHF, HF, TACAN, ILS, Inter-Com).
>
> While this was going on, we also had our servicing to accomplish, Liquid Oxygen (no power on or anyone else on aircraft at that time), Chemical Ignition System (CIS) (TEB) (again no one else on the aircraft and no fuelling at that time), lubrication of the NLG (after refuel), Fuel, (most times a 45K [45,000lb] load or if it's a rocket ride 65K after purging fuel tanks YO YO), liquid nitrogen LN2, hydraulics, gaseous servicing N2 bottles, tyres, (tyres were serviced six to eight hours before take-off and then again two to three hours before take-off), accumulators, etc, cockpit cleaning.
>
> In between all of that you had your sensor shops trying to upload their sensors and check them out. Hopefully you didn't have a nose change (radar to photo or vice versa), as this threw in a little more work to your already busy schedule.
>
> From start to finish (launch), you were looking at a good three shift operation, starting with dayshift and continuing through swing shift and mid shift depending on how well it went maintenance wise. Some sensors required a preheat period, 18 hours for the OBC, so power and air on the aircraft was required prior to launch; TEOCs were a six-hour preheat time. A good 24-hour period of work by at least 25 people was required to accomplish this, and if the mission was scheduled as a backup, then this would generate double the workload.

Virtually everyone connected with the SR-71 programme were highly motivated individuals, but as in any organisation there's always one who's the exception to the rule, as S/Sgt Skip Holser explains:

> We had one guy on the SR-71 flightline maintenance swing shift that we could never find to do any work. One night, as usual we couldn't find him. The search is on. We push open an aft blow-in door near the engine exhaust on one of the aircraft and there he is, inside sleeping with the exhaust plug pulled in.
>
> Plan A: Let's get a Buick start cart!
>
> So we put it under that engine, hit the starter and put the throttle full down and up a couple of times…Never have I seen an exhaust plug coming flying out so fast with a person right behind it.
>
> Problem solved!

SERIOUS MAINTENANCE ISSUES

During the mid-1970s, the SR-71 programme was plagued by a serious shortage of qualified maintenance technicians. This manifested itself in an increase in quality issues and aircraft aborts. On the shopfloor, Skip Holser recalls a couple of incidents that resulted from what should have been very straightforward tasks:

> We started having problems with personnel being transferred in from other USAF organizations that just didn't understand the uniqueness of the SR-71 and its maintenance requirements. I'm not saying that everyone we got was a problem, just a few – most of them tried to learn the aircraft and got to be an asset.
>
> There was the case of a SMSgt who, because of his rank, was immediately put in charge and tried to apply USAF rules to an aircraft that leaked fuel. Now clearly that wouldn't be allowed to happen on other USAF aircraft, so he was clueless when it came to the SR-71.
>
> For example, when the SR-71's fuel tanks were pressurized with LN2, we could lose 6,000lb of JP-7 on the hangar floor in 30 minutes during pre-launch. As another example, I have had a Buick start cart engine blow-up during launch and one of its piston rods lay in a puddle of oil on fire – we used JP7 fuel to put it out!
>
> Anyway, this new SMSgt saw how we loaded the drag 'chute, four guys pick it up put it on the inboard wing, drag it back to the drag 'chute compartment load it and that's it, job done. Well according to him that was wrong as it exceeded the weight limit you were supposed to pick up – the drag 'chute weighed 211lb, but we had four guys sharing the load. Anyway, he insisted that a B4 stand be used.
>
> Ten days later, they jacked up a B4 stand to load the drag 'chute and smashed into the composite chine leading edge. Result: $1,500 worth of damage.
>
> Can we stop using the B4 stand now? NO!
>
> Three weeks later, after a drag 'chute had been loaded using a B4 stand, we found a perfect donut-size hole in the right inlet spike. We now have a trashed inlet cone.
>
> We discovered that the incident happened when two swing shift guys, both massive and powerlifters (225–250lb each easily), plus the 211lb drag 'chute were on the B4 stand with all that weight.
>
> The B4 stand was jacked up, the 'chute loaded, and lowered.
>
> What did they forget to do? Put the stand safety pins in place to take the pressure off the stand actuator. Once they got off the stand with the 'chute, taking 600lb plus off the stand, it rose up and the mount point for the rail went into the spike.
>
> Wait there's more!
>
> The spike was changed but two flights later we have a FOD'd engine due to a nut from the spike roller coming off and going down the inlet. The cost for shipment and rebuilding the engine: around $1,000,000.
>
> No more B4 stand after that, back to the tried-and-tested way of installing the drag 'chute.

The maintenance situation at Det 1 had deteriorated to such an extent by mid-June 1977 that its Maintenance Officer, Lt Col Dave Fruehauf, took the decision to constructively record the concerns he had been discussing with his superiors and circulate them in a document to senior maintenance officials at Beale, Offutt, 15th Air Force at March AFB, 14th Air Division at Beale AFB, Det 51 at Norton and HQ USAF Washington DC, all of whom were cleared to receive such traffic.

Raising his concerns in a direct, forthright manner went beyond what might normally be expected from a Maintenance Officer, but they were grounded in his significant personal experience. Prior to becoming Det 1's maintenance officer, Dave headed up the 9th SRW's Organisational Maintenance Squadron (OMS), where he had gained crucial experience in quality control. But perhaps of greater relevance was the 670 flying hours he'd logged as an SR-71 pilot, during which time he had had to eject from '957, the two-seat pilot trainer, due to some extent to the result of a maintenance failure (a double generator failure). In short, he was well aware of the high price of learning.

For reasons that remain unclear, Dave's document listing his concerns was backchannelled by an unknown addressee and ended up in the hands of at least one general officer.

Despite there being no evidence of a lapse in protocol, or that the content of the document was factually incorrect, Dave was removed from his post. His boss the Det 1 Commander Col Abe Kardong (also an ex-SR-71 pilot who coincidentally had also piloted an SR-71 that was written off in an accident – a wheel failure on take-off that triggered a fire) mounted a robust ten-point defence of his head of maintenance, referring to the fact that 13 previous messages had been issued by the Detachment covering subjects raised in Dave's summary.

‘972 continued the work of ‘955 after the latter’s retirement. The new kid on the block was flown into Norton AFB on 22 October 1987 by Tom Tilden and JT Vida to participate in the base’s open house. (Tony Landis)

Dave’s personal sacrifice was not in vain, as Mike Relja recalls,

> When Dave wrote his letter, the only permanent positions at the Det were the Supply personnel, Maintenance Control which included myself, and the Command Staff CC, DCM etc. They then started to PCS [Permanent Change of Station] in highly qualified people from Beale, CMSgt Don Campbell OMS, CMSgt JT ONeal FMS and CMSgt Sam Patten AMS. They also started to PCS in the maintenance guys from Beale in those three organizations; when that happened, we really had a great bunch of guys that knew their stuff. It didn’t help Beale very much since they had to train replacements but it was a pleasure at the Det. I left there in 1980 and went back to Beale when we started to lose those highly qualified guys at the Det and they started going back to Beale and less experienced guys replaced them. It really was a circle of up and down experience at both the Det and Beale.

RECOVERIES AND PDM

If an SR-71 was forced to abort its mission and land away from the base from which it was operating, a maintenance recovery team was dispatched in a KC-135Q, carrying the necessary equipment to repair the aircraft to a level that enabled it to return safely to the detachment or Beale. Mike Relja provides an insight into one such incidents involving 61-7971 on 26 June 1981, which had to abort during a routine stateside training sortie.

As the Maintenance Supervisor, I received a debrief over the phone from the crew as to their problem. As in all recoveries, you take a minimum maintenance crew and the minute you get to wherever, go to work, fix the aircraft and get it home ASAP.

We arrived at Buckley Field, a Colorado National Guard base near Denver late the first night. All the necessary support equipment, Buick start cart, spare parts, you, your guys, as well as the JP7 fuel, etc. was loaded on the KC-135Q tanker, at Beale prior to departure.

On arrival, the first thing we did was off-load equipment from the tanker and run the SR-71's engines to confirm what the aircrew had debriefed over the phone – that the left Accessory Drive System (ADS) had failed. When the ADS fails, you also lose the generator, two hydraulic pumps (A system, flight controls and L system, landing gear, brakes, etc.), as well as the fuel recirculating pump on that side. The ADS is connected to the engine by a Bendix Drive shaft. Since our arrival at Buckley was so late, I got the guys some rooms for the night.

We started to change the left ADS the next morning. After removing all the accessories attached and removing the Bendix Shaft, the accessory drive itself was removed and replaced. Then all the accessories, the generator, hydro pumps, fuel pump, etc. were reinstalled, as well as the Bendix Drive shaft. The hydraulic systems had to be filled and bled to remove any air, the engines were run to check for any leaks and the ADS and generator operation/function also had to be checked. The aircraft was then post-flighted, pre-flighted, serviced and LOX, TEB, fuel, etc. added to go home.

Refuelling on recoveries was always interesting away from home, because you would park the SR-71 next to the tanker, start one of the engines on the SR-71 and the tanker engine farthermost from the SR-71. Fuel would then be pumped from the tanker to the SR-71 via a hose connecting both aircraft. It would drive the local base fire department crazy when you asked for a stand-by fire truck and you were refuelling with both aircraft engines running. Servicing TEB does not help the situation either!

Once the Bendix Drive shaft had been removed and replaced, you had to do a MIL power, engine run vibration check. But since we had no place to do that on the ramp, we left that for the aircrew to do on the take-off checks before launching for home. We balanced the drive shaft during installation and had the vibration meter hooked up during the launch. After the aircrew completed the MIL engine run and the vibration check was OK, we just had one extra panel to attach. After the launch, the aircrew always put on a little mini air show for the base, before heading home.

There was a small base exchange (BX) at Buckley, and since it was a Colorado National Air Guard Base, they had CAG [Colorado Air Guard] hats for sale, so we all bought one and wore them during the recovery operations and launch. The locals got quite a kick out of it.

While the ADS system was always prone to failure, numerous Service Bulletins over the years improved it, but did not totally eliminate failures. A replacement ADS and Generator system was in the works for Flight Testing when the SR-71 programme was unfortunately terminated in the early 90s.

Three months later, on 2 September 1981, I had to recover 61-7971 for a second time. On this occasion, I had to fly up to Fairchild AFB, Washington, due to the inflight loss of the left (L) Hydraulic System that controls the landing gear, left spike and forward bypass doors, etc.

After landing at Fairchild, the aircrew performed their maintenance debrief over the phone, the tanker was loaded with a minimum maintenance crew, equipment, spares, etc. and again, I was the assigned Maintenance Supervisor.

Once at Fairchild, we downloaded the tanker equipment and verified the L hydraulic system failure by the fluid still leaking out of the nacelle. Removing the lower louver panels revealed a broken L System hydro line. We called Beale and had the line pulled from supply and a T-38 flew it up to us.

Most hydraulic line failures are caused by corrosion, but sometimes they occur from the inside out, because too much oxygen is left in the hydraulic system when it is filled and bled by maintenance. It can also happen by a pre-load put on the line during the last installation, and vibrations finally get to it. Once you've suffered a complete hydraulic failure, the pump must be changed too, due to metal contamination.

Once the broken line and pump are removed and replaced, the hydraulics are filled and bled, engines runs are made for leak checks and system operations are completed. The aircraft is then post-flighted and pre-flighted, serviced, fuelled, etc. ready for the return trip home.

An interesting aside from this trip, because my guys had been working all day without any meals, the Lockheed Tech Rep, Maintenance Officer and me went and bought some pizzas, beer and sodas for the crew. We had everything in the back of a USAF pickup truck that the base had loaned us. The guys came out of the hangar to eat some pizza and have a beer or soda, then obviously they were back to work.

Unfortunately, as one of the guys was going back to work, he threw an empty beer can into the hangar trashcan, instead of leaving it outside by the truck as the others did. The Security Guard assigned to guard the aircraft called his supervisor and told him that the guys were drinking beer in the hangar and working on the SR-71.

The Security Police Supervisor came down and placed my guy under arrest, even though we tried to explain he had only had one beer outside the hangar, and had thrown the empty can in the trash. No one was 'working' on the aircraft and drinking, in fact I had a beer myself, but they hauled him away anyway.

The Lockheed Tech Rep, Maintenance Officer and myself went to the Security Police HQ and explained to the desk sergeant what had happened and he released my guy. But by the time we got back to Beale, word had already made it back and I was called into the OMS Commanders office to explain what had happened. The Lt Col asked me why I hadn't set up a dayshift and nightshift. I explained that we take a minimum crew on recoveries and don't have enough people to setup shifts. We just work until the aircraft is fixed and it and we head for home. Even for recoveries at Beale, where we have rooms, we don't usually get to use them.

He said 'Okay, but next time take more people.'

'Yes, Sir right!'

PROGRAMMED DEPOT MAINTENANCE (PDM)

Mike Relja now outlines PDM.

I got to Flight Test/PDM in 1981 while I was still in the USAF and assigned as the Air Force Quality Assurance Representative [AFQAR], performing quality assurance acceptance for Det 6 on the flight test and PDM aircraft that came through. When I retired from the Air Force in 1988, Col Don Emmons hired me back as a GS12 civil servant, and I worked as the Air Force Project Administrative Officer [AFPAO] on the PDM aircraft. This programmed depot work was pre-negotiated and funded, but any discrepancies found by Lockheed during the performance of the inspections, service bulletins, time changes, functional checks, etc. were considered 'over and above'. I had a budget of around $1.1 million per aircraft to pay for those discrepancies. I had the option of saying 'work' or 'don't work' the discrepancy if I thought it was minor or cosmetic in nature.

If I decided to have Lockheed work the discrepancy, I'd negotiate the man-hours with the Lockheed supervisor involved. If we couldn't come to an agreement, we'd send it up the chain, he with his Lockheed people, and me to the Det 6 folks. This was in place from 1988 until the Senior Crown programme was terminated. Prior to that Lockheed would fix everything, they'd write it up and then send the bill to the Air Force. When the USAF budget was cut back, we went to the above system of negotiating the 'over and above' discrepancies.

The PDM contract was negotiated a year in advance, so the FY89–90 PDM contract was negotiated on 11/12 August 1988 for example. The man-hours for each task on the incoming PDM aircraft would have an ADP proposal, a Det 6 position and the negotiated hours.

The PDM schedule for the FY89–90 timeframe were aircraft 61-7980, 61-7971 and 61-7956. 61-7980 was completed in September of FY89, 61-7971 was started in May of FY89 and completed in February of FY90, and 61-7956 was started in October of FY89 and was scheduled for completion in July of FY90. However, due to programme cancellation, the PDM was terminated in November of 1989 and the B model placed into storage. The second effort to complete the B model PDM started in October 1990 and was completed in July 1991.

The aircraft were due a PDM every 800 flying hours, which would mean I would see a particular tail number every four years, depending on the flight schedule SAC put it through. At the time of cancellation there was talk based on the fact of not finding significant problems during previous PDMs to move the time out to 1,200 flying hours or maybe higher. The aircraft would be in PDM for 9–10 months, depending on the amount of work programmed for that tail number.

Using 61-7980 as an example, as per the contract, we would complete the following inspections: time changes, service bulletins, fuel tank repair, general PDM items such as paint systems, functional tests, SRA-CP-141 FCP Center Stand x-ray, fuel leak checks, left/right nacelle, NLG door split line germ seal replacement. We would complete at least two FCFs with two hot legs each, and then make a delivery flight back to Beale after paint.

Depot Maintenance Tasks	
Task	Man-hours
Inspection Group 1 Pre-flight/Post Flight	1,350 man-hours
Inspection Group 2	400 hours
PE [Periodic Inspection]	1,200 man-hours
Inspection Group 3 Depot Level	4,500 man-hours
Inspection Group 4 Depot Level 2400	125 man-hours
Inspection Group 5 Depot Level 4100	7,175 man-hours
Inspection Group 6 Seat Track Holes	16 man-hours
Fuel Tank Repair Fuselage/Inner Wing	6,300 man-hours
Fuel Tank Repair Outer Wing	3,000 man-hours
Fuel Tank Repair Wet to Dry Bay	480 man-hours
Tank Shims	480 man-hours
General Painting	150 man-hours
System Functional Test	6,400 man-hours

SRA-CP-141 Center Stand	140 man-hours
Fuel Leak Checks	40 man-hours
Left and right Nacelle/NLG Door Split	116 man-hours
Line Germ Seals	116 man-hours
Time Change Group 1	825 man-hours
Time Change Group 2	150 man-hours
Time Change Group 3	80 man-hours
Modification Group 1, 3in. ADI	230 man-hours
Modification Group 2	97 man-hours
Palmdale Inspection	4,000 man-hours
Burbank Support	1,180 man-hours
Pool Charges at 1.3%	395 man-hours

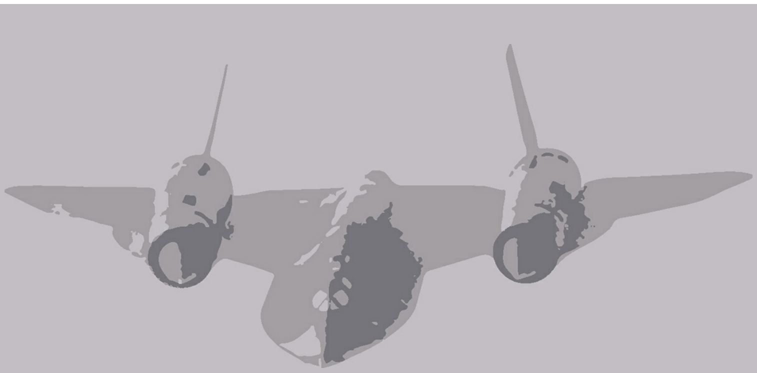
When we delivered 61-7980 the summary report was:

Duration	9 months
Total Man-hours	27,548
Total Removals	2,233
Total Squawks	2,261
Total E.I.s	229
Total Service Bulletins	27
Total Time Changes	209

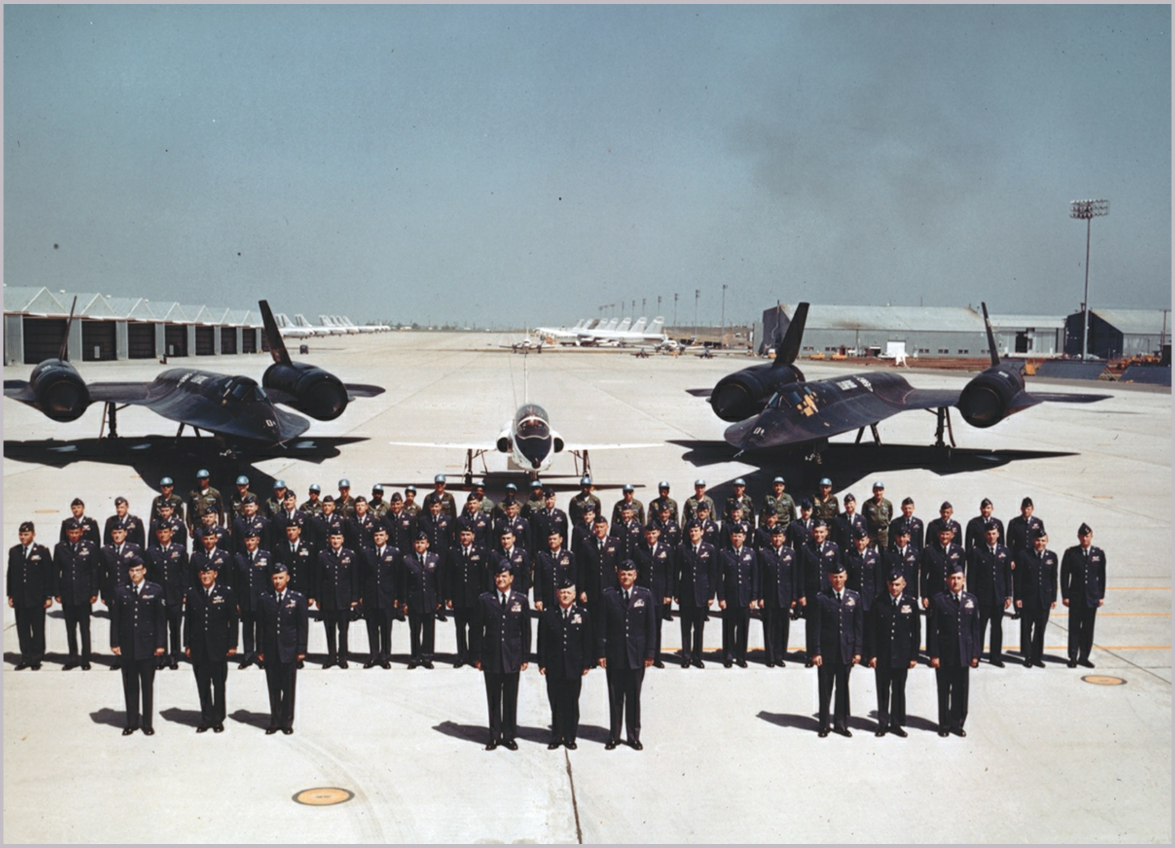
All the above PDM work is quoted from the *SR-71-6 Aircraft Scheduled Inspection* and *Maintenance Requirements for SR-71, SR-71B and SR-71C Aircraft*, as well as the negotiated PDM Contract.

In the early days of SR-71 operations there were more periodic inspections with less flight time in between, until the aircraft became more reliable and personnel gained experience. Back then, the man-hours per flight-hour ratio was about 735.

After many years of operation in which crews and maintenance personnel gained experience and improvements were made to the aircraft, the time between teardowns was extended. Reliability increased and with no significant problems emerging during inspections, the man-hours per flight-hour ratio fell to around 125 hours.



CHAPTER 12:
BEALE OPERATIONS



Standing to attention in front of SR-71s ‘958, ‘970 and a T-38, this picture taken on 27 May 1967, depicts the initial cadre of the 9th SRW. They are, from left to right, front rank: Sgt Dave Gallard, Jack Kennon (Operations Officer), Ray Haupt (1st SRS Commander), Hal Confer (Deputy Commanding Officer), Bill Haynes (9th SRW Commander), Charles Minter (9th SRW Vice Wing Commander), Harlon Hain (Operations Officer) and MSgt Loignon. The pilots in the second row are paired with their RSOs, who stand behind them in the third rank as follows: Storrie/Mallozzi, Sowers/Sheffield, Hichew/Schmittou, Collins/Seagroves, Bill Campbell/Pennington, Halloran/Jarvis, Brown/Jensen, Dale Shelton/Boggess, O'Malley/Payne, Walbrecht/Loignon, Boone/Vick, Bevacqua/Crew, Watkins/Dempster, DeVall/Shoemaker, Spencer/Branham, McCallum/Locke, St Martin/Carnochan, Bull/McNeer, Powell/Kendrick, Daubs/Roetcisoender, Bobby Campbell/Kraus, Kardong/Coleman, Maier/Casey, Fruehauf/Unknown and Hudson/Ferrell. Finally, behind wearing baseball caps are the Crew Chiefs. Unfortunately however, to date no one has been able to identify them all. (USAF).

The majority of SR-71 operational missions were conducted from within theatre, namely Detachment 1 at Kadena AB on Okinawa and Detachment 4 at RAF Mildenhall, in the United Kingdom. That said, there was always plenty going on at 'home plate', Beale Air Force Base, in California.

TANKERS

It's impossible to overemphasize the essential role played by the KC-135Q tanker crews, without whom successful prosecution of the SR-71 mission would have been impossible. It became apparent to SAC that the tanker force dedicated to supporting SR-71 operations would need to be expanded beyond the original 21 Q-model aircraft and in 1967 the decision was made to modify an additional 35 aircraft. Some 20 KC-135As from the 70th AREFS, 43rd BW at Little Rock AFB, Arkansas, and 15 from the 306th AREFS, 306th BW at McCoy AFB, Florida were therefore converted.

However, to save costs these aircraft weren't equipped with the full avionics suite found on the KC-135Qs stationed at Beale and were known informally as 'partial Qs'. These additional '135s lacked the AN/ARN-90 TACAN and LORAN A (the latter was subsequently removed from the Beale aircraft). Instead, these partial Qs relied upon an AN/ARC-50, known as 'Comm 3', to provide air-to-air distance measurement for the rendezvous between tanker and receiver.

There were two types of rendezvous used by KC-135Qs during missions in support of the SR-71. Other than differences in timing, these two procedures were identical. The first, known as the 'cold' rendezvous, was used when the receiver was subsonic prior to the air refuelling, such as for the initial fuel on-load after take-off or during pilot qualification training. The 'hot' rendezvous was used when the receiver was supersonic prior to the air refuelling, which was usually the case during an operational mission or ferry flight.

The KC-135Q could simultaneously carry a maximum of 74,490lb of JP-7 and 110,000lb of JP-4 for its own engines. To account for changes in the aircraft's CG during refuelling operations, 850lb of ballast was added to the lower nose compartment. The refuelling operation was conducted at 355 Knots Indicated Airspeed (KIAS; red-line speed for the KC-135Q) and within a block altitude of FL260-270, a height lower than SR-71 crews preferred, but as high as a fully laden KC-135Q could reach while maintaining 355KIAS.

Colonel Bill Haynes led a highly skilled team of USAF maintenance technicians as they brought the SR-71 into operational service. He chose some of the best crew chiefs and maintenance supervisors in the entire Air Force. Top, from left to right: Allen, Harrah, Kennedy, Mitchell, Martin, Darby, Schwarz, Hansen, Anderson. Bottom, from left to right: Spangler, Dunn, Person, Nickerson, Smith, Hornbrook, Vasquez. (USAF).

Approaching the end of the air-refuelling task, the SR-71 was at the limits of its subsonic heavy-weight performance envelope and the pilot would often engage one afterburner and cross-control the aircraft to mitigate against the effects of asymmetric thrust in order to stay in contact with the tanker. Much later in the programme, tests conducted with KC-135Rs showed a 20KIAS increase in the tanker's maximum speed, allowing the SR-71 to refuel at 375KIAS, a considerable improvement, especially during heavy-weight operations.

On 17 June 1970, Maj Buddy Brown and Maj Mort Jarvis were to fly a special mission to check out a new jammer and verify some changes that had been made to another high-powered jammer. The test was to be conducted over the Gulf of Mexico in the Eglin Test Range, which was instrumented for tracking high-altitude targets. The flight took them around the western US toward a second air refuelling near El Paso, Texas before the planned high and hot run across the Eglin Test Range. The flight, which began at 07:30am at Beale, went well until the split-off-load air refuelling from two tankers. Buddy described what happened next:

> When we completed the rendezvous, I pulled up into the pre-contact position and waited for the 'cleared for contact' call from the boomer. After receiving the call, I flew to the contact position and waited for the boom to be inserted into '970's receptacle. I got the nozzle contact light and started taking on fuel. I remember commenting to Mort on how smooth the air was that morning; there wasn't any turbulence that one sometimes felt on the eastern side of the mountain range around the El Paso area in the summer time.
>
> During the refuelling I was following the directional lights on the bottom of the tanker to keep position 'in the green' (the centre of the air refuelling envelope). After we'd taken on about 35,000lb of fuel, a crewman called over the boom-linked interphone that I had taken the required amount of fuel and that they would initiate a disconnect on the count of three. At the end of the count, I felt the disconnect, throttled back, dropped down and back slightly and spotted my second tanker, which was to my right.

BROWN/JARVIS

On 17 June 1970, Majors Buddy Brown and his RSO Mort Jarvis ejected and survived, having been involved in a mid-air collision with a KC-135Q tanker. (USAF)

I moved to the pre-contact position behind number two, reset my refuelling system for contact and called that I was ready to refuel. The second boomer acknowledged ‘ready to refuel’ and I pulled into the contact position and waited for boom contact. Shortly thereafter, the boom made contact, which I again verified by feel and the ‘contact-made’ light on my instrument console, and continued with what I expected to be a routine air refuelling. Two or three minutes into the second refuelling, the aircraft hit a sort of bump and shook as if it had just flown through some turbulent air. I asked Mort, ‘Did you feel that?,’ to which he emphatically answered, ‘Yes’. It felt quite unusual because the air had been so smooth that morning. It may have been another aircraft’s jet wash that was laid across our track by an airliner that had passed earlier. Again, there was another disturbance that I corrected with a small stick input. Then it was quiet and smooth again.

80054
U.S. AIR FORCE
0054
17970
13282
U.S. AIR FORCE

SR-71 ‘970 crashed and was completely destroyed following the mid-air collision. (USAF)

Out of nowhere, the nose gave a small pitch down and a hard pitch up. I pushed the stick quickly forward, but the nose and canopy struck the bottom of the tanker. The nose section was gone just forward of the cockpit and the canopy had caved in on me. I thought, ‘I’m inside the tanker; death is imminent!’

My next thoughts were about bailing out, so I told Mort to bail out and pulled the ‘D’ ring between my legs. I still thought I would eject up inside the tanker. There was a lot of noise and debris flying around as I was pushed down into my ejection seat by the rocket that was firing me free of the aircraft. Next, I was aware of free falling in my ejection seat, whose ’chute was stabilizing my descent toward 15,000ft where the butt-snapper lofted me out of my seat and my pretty parachute opened automatically. I opened my visor to look around the sky for my RSO, the Habu [SR-71] and the tanker.

The tanker was making a turn overhead and Mort was about 1,000ft below me in his ’chute. I didn’t realize it at the time, but both my legs had been broken during the ejection. They were numb from the break and I couldn’t feel a thing. During the descent, I looked at the ground and contemplated my landing. When I hit, I was dragged a few feet before I got one side of my parachute

> unhooked. I then unhooked the other side, crawled over to my seat kit and got the emergency radio out. I called the tanker and said that I was OK and asked if they had contacted my RSO. The tanker crew responded affirmative to both questions and waited for us to be picked up by a chopper from the Fort Bliss Army Hospital at El Paso, where the doctors checked us over and splinted my legs.
>
> My aircraft had smashed into the ground approximately 20 miles east of El Paso at 09:15am. The tanker flew back to Beale, did an inflight controllability check with an approach to landing speed and determined it was safe to make a landing. After it rolled to a stop off the Beale runway, it was encircled by fire trucks and Beale officials, who were amazed at the amount of damage inflicted to its tail, and how that tough old bird was able to continue flying with a severely damaged horizontal stabilizer.

Buddy recovered from his broken legs, was cleared to return to crew duty later that year, and served a full career as a senior staff officer.

EAGLE BAIT

During the early 1970s, an evaluation programme began involving SAC's SR-71s and Tactical Air Command's (TAC's) new F-15 fighters. Its purpose was to determine the interceptability of the SR-71 by the F-15 Eagle, which had speed and altitude characteristics similar to those of the MiG-25 'Foxbat' – the very high-altitude intercept training would also be useful for the Eagle 'drivers'. The programme initially got off to a bad start with inter-command rivalries coming into play, as Buddy Brown recalls:

> I was briefed on the particulars of one F-15 intercept training mission the day prior to the flight. The intercept was to take place in the Edwards Test Range area in California. We were to pass on our exact time, heading and altitude as to when we would be at a specific location over the range, to assist the intercept as much as possible, the day before the sortie. Additionally, we were to let down to 70,000ft and slow to Mach 2.85, again to assist the F-15's intercept geometry.
>
> Just prior to our arrival at the 'start of intercept point', I was asked to dump fuel for approximately 15 seconds to mark my position in the sky. I was told that ground radar sites had got the F-15 lined up so that the pilot could make his pull-up at the right moment and 'acquire' my aircraft on his on-board radar. He called back a successful 'kill' on the SR-71. Immediately TAC Headquarters put out the word that they could shoot down an SR-71 because they had intercepted one.

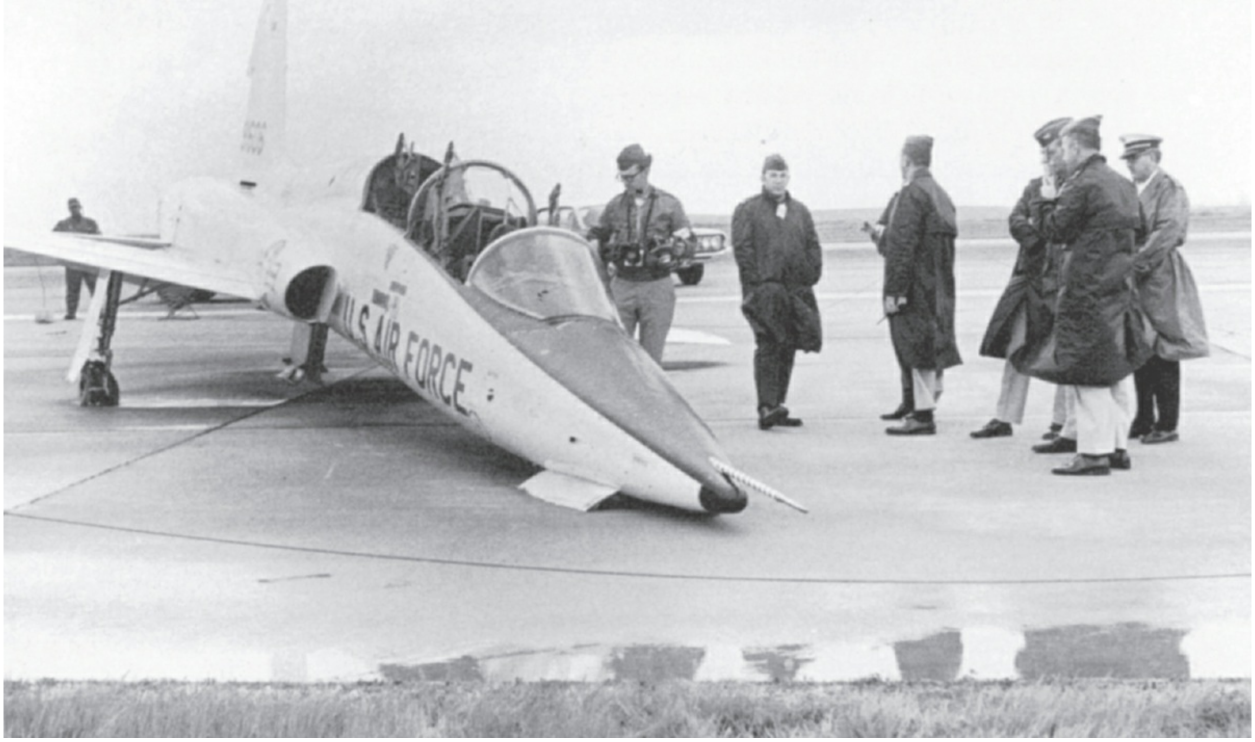
KC-135Q 59-1474 seen at RAF Mildenhall in September 1971 15 months after it's mid-air collision with '970. (Richard Vandervord)

Well, this did not go down well with the troops back at Beale, because they had given the F-15 guys everything they needed to make the intercept. We had not even used our DEF system to jam them. Prior to the next mission, TAC asked for the usual information (position, altitude, speed and heading). We replied, 'We'll be in the Edwards Test Area tomorrow.' An HQ TAC staff officer protested, 'But we need the information to make the intercept.' Our reply was, 'Why? You claim you can intercept and shoot down an SR-71.' For the next two missions, the F-15 crews were unable to get anywhere near us; we didn't slow down or descend. They retracted the earlier claim, and from that point on we gave them the information they needed to ensure that the mutual training exercises were beneficial to both parties.

SUPERTANKERS AND LONG FLIGHTS

General P. K. Carlton, commander of the 15th Air Force, became interested in extending SR-71 missions to fully encompass the concept of 'global reach'. In 1970, he initiated two actions that hastened very long-range operations.

The first covered nuclear war reconnaissance. He asked his Director of Reconnaissance, Lt Col Don Walbrecht, to conceive a post-SIOP (Single Integrated Operational Plan) coverage of the Soviet landmass by SR-71s, assisted by advanced tankers that were not yet programmed into SAC's inventory. He said, ''Recce', you know that Habu: Well, I want a plan to help sell the Air Staff on the idea of big new tankers.' In the next few days, Don and his fellow 15th AF reconnaissance officers drew up a plan whereby the existing SIOP was covered with lots of tankers and all of the SR-71s.



T-38 Talon 59-1606 was lost at Beale on 23 March 1971 when its elevator controls failed on take-off. Major Jim Hudson, an SR-71 pilot, was killed when he ejected too low for his parachute to fully deploy. Lt Col Jack Thornton stayed with the uncontrollable aircraft, sustaining back injuries. Hudson was the only Air Force SR-71 pilot to be killed during the entire Senior Crown programme. (Appeal Democrat via Tony Landis)

After Don briefed the 'Boss' the first time, P. K. said, 'Back to the drawing boards, Recce; you're not thinking big.' A few days later, a new plan was briefed, showing that a dozen prepositioned KC-747s and a dozen Beale-based Habus could cover all probable targets less than five hours after the initial ICBM lay-down. 'That's more like it!' he said. 'That'll help advocate the use of the Jumbos.' Soon after, newly promoted Col Walbrecht found himself assigned to SAC Headquarters, where he was 'advocating new tankers and re-engined KC-135s' as the division chief of advanced strategic aircraft systems.

To further the cause of an advanced tanker, General Carlton stimulated a test programme that mated Boeing's modified number one 747 test airframe with an SR-71. On 6 July 1972, Merv Evenson and Coz Mallozzi flew the Palmdale test airframe '955, on a three-hour sortie checking out refuelling flight envelope and 'dry-boom' contact checks with the boom-equipped 747. The same day, B-52s and various fighters also took their turn in the 747 contact tests.

Throughout the 1970s, General Carlton used the 747/SR-71 recce concept, and the success of that test flight, to help promote SAC's advanced tanker programme, which eventually bore fruit in the 1980s with the purchase of 60 KC-10s. For SR-71 pilots, the KC-10 made the air-refuelling task much easier, raising the base refuelling block up to 33,000ft and the speed to Mach 0.88.

JACK'S HOUSE

Long before the SR-71 began operating from within Europe, it was envisaged that one or two aircraft would be pre-positioned to Eielson AFB, Alaska, from where they would conduct pre- and post-strike reconnaissance into the Soviet Union as part of the SIOP. An esoteric asset that was to form part of this plan was 'Jack's House'. The facilities' name came from its onetime caretaker-captain, named Jack. As Don Walbrecht recalls:

> The empty hangar sat on the southwest side of Eielson AFB and had stood there before our SR-71 ops at Beale began… In 1970, whilst a staff officer at HQ 15th Air Force and Lt Gen Jack Catton's specialist on Recce matters, I was invited by the 15th AF HQ's Inspector Team's Chief, to serve as his 'Inspector' of classified Recce functions at the 6th and 9th Reconnaissance Wings. At Eielson, I was asked to inspect 'Jack's House,' which had long been a pain to many sub commanders on the base, who desired use of that unused facility. I never met the so-called Capt Jack, but was escorted by a senior NCO into the hangar which was empty, except for a brand new five-year-old staff sedan, a fuel truck and a nearby JP-7 fuel tank. Even the RC-135D operation at Eielson was not connected to that

> facility. I heard much later that one SR-71 exercised that facility and after the entire site was turned over to the 6th Wing for its own use.

The exercise involved ’972, and it occurred under the codename Glowing Light between 26–30 September 1972. It can only be assumed that ‘Jack’s House’ was abandoned for SR-71 operations in favour of operating from the UK.

THE LONG HAUL

Another P. K. Carlton initiative was to prove that the SR-71 could fly longer than eight hours. In March 1971 he asked Don Walbrecht how long the Habu could fly on a maximum-effort mission. Don replied, ‘About nine and a half to ten hours.’ ‘What’s the limiting factor, TEB?’ asked the general. ‘No, sir,’ replied Don. ‘It’s the liquid nitrogen used to pressurize the hot fuel tanks while flying at high Mach.’ After considering the answer briefly, P. K. instructed Don to ‘get with Hal Confer,’ who commanded the 9th SRW at the time, and have him set up the longest sortie possible. ‘Go for ten hours!’

Following their record-breaking long-distance flight of 26 April 1971, Tom Estes and Dewain Vick received the 1972 Harmon International Trophy. The award was made on 20 September 1971 in a ceremony at the White House. Present are, from left to right, Senator Barry Goldwater, Lt Col Tom)Estes, President Richard Nixon and Lt Col Dewain Vick. (USAF)

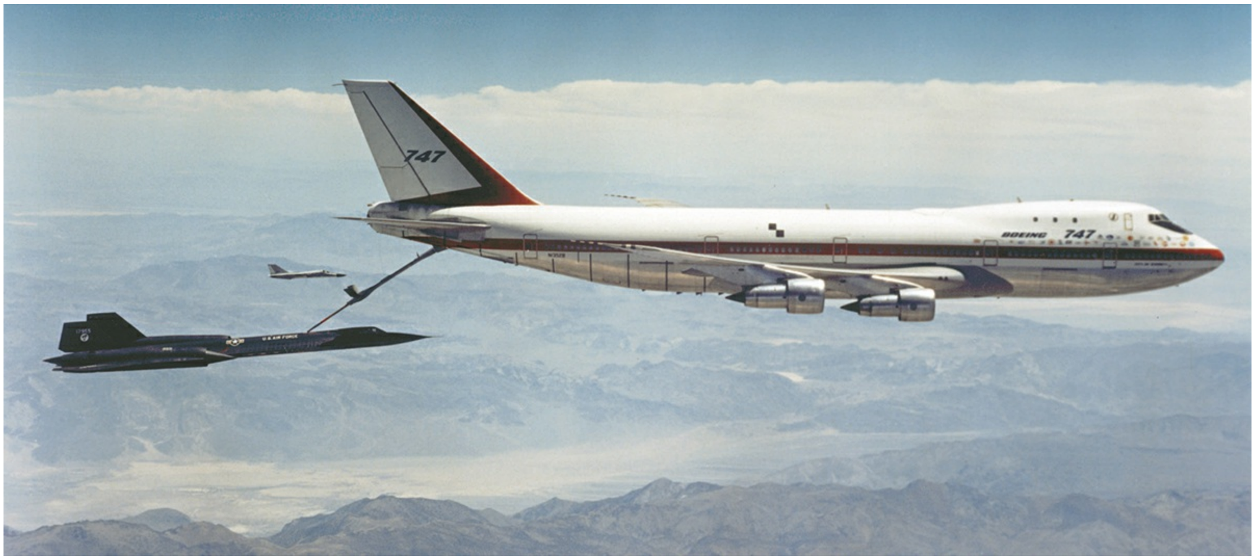
Colonel Pat Halloran headed the SR-71 detachment at Griffiss AFB, New York. Air Force Logistics Command deployed '955 to Griffiss under the codename Black Knight, to evaluate a new DEF system. This exercise provided a useful cover story for a series of 11-hour transatlantic round-robin missions over the Middle East. (Tom Pugh)

In compliance with those instructions, Col Confer said that he would pick a tight aircraft (one with new tank sealant to reduce nitrogen leaks) and get on with it the following week. On 26 April 1971, Maj Tom Estes and Maj Dewain Vick established an endurance record for the SR-71 in aircraft '968, when they stayed aloft on multiple high-Mach legs for ten hours and 30 minutes, covering a distance of 15,000 miles. The mission involved five full-up aerial refuellings and 5½ hours of Mach 3.0 time. The flight completely encircled the continental United States twice and ended with a high-Mach run around the western states. Three refuellings were done between Reno and Boise and two near Florida. The nitrogen dewers still had a little LN2 remaining and the aircraft had minimum maintenance write-ups.

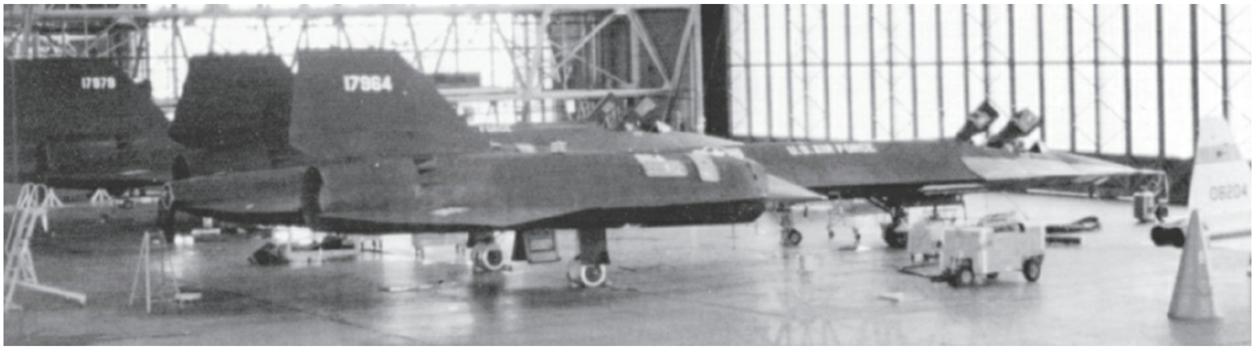
Crew fatigue had been a minor problem, but Tom and Dewain were greatly inspired to make the mission a full success. Dewain recalled taking along a packet of M&M chocolates. 'Each time Tom descended for a refuelling, I'd pop my visor and quickly take on my own refuelling (a few chocolates) and quickly reseal my visor. I guess I should have contacted the Mars company for a product endorsement – M&Ms really do melt in your mouth and not in your pressure suit glove!' After 13 hours in their pressure suits, both crewmembers recalled that the UCDs also worked as advertised.

In recognition of this outstanding achievement, Tom and Dewain won the

1971 Mackay Trophy for 'the most meritorious flight of the year', and the 1972 Harmon International Trophy for the most outstanding international achievement in the art and science of aeronautics. The SR-71's 'long legs' were soon to be used in double-transatlantic sorties.



On 6 July 1972, Merv Evenson and Coz Mallozzi flew a 2.7hr sortie in '955 checking out the refuelling flight envelope and 'dry-boom' contact checks with the boom-equipped Boeing 747. (USAF)



Aircraft '979 and '964 are pictured in a hangar at Griffiss. T-38 Talon Toxon 01, just to the right, was used to chase '955 during the subsonic phase of its test flights. (Tom Pugh)

Lt Cols Jim Shelton and Gary Coleman completed the first round-robin mission from Griffiss over the warring Middle East factions. Jim is seen here earlier in his career. (Jim Shelton)

THE 1973 OCTOBER WAR

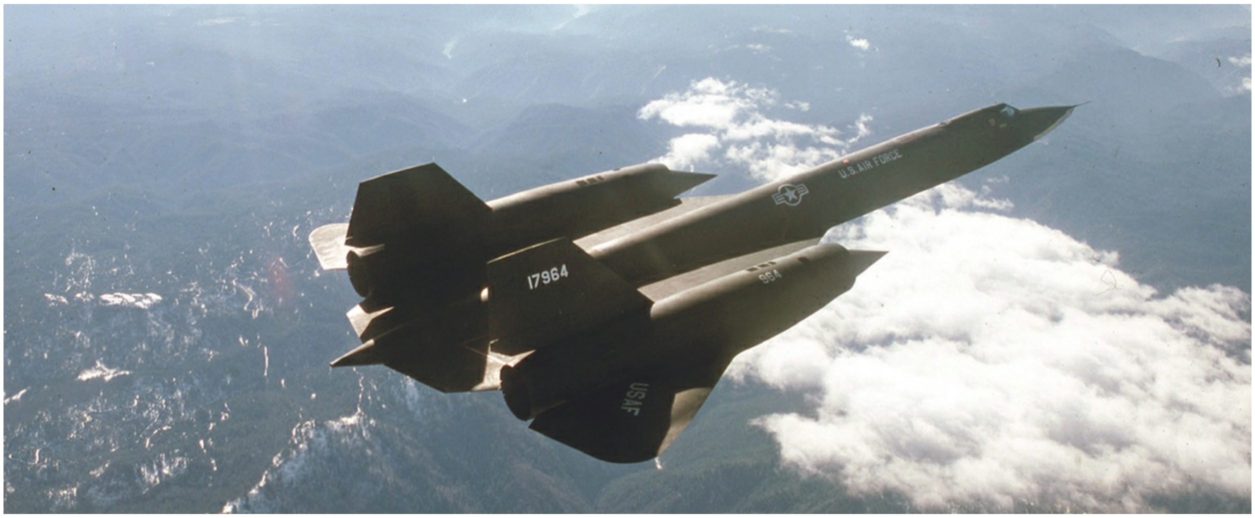
After Israel emerged victorious from the 1967 Six Day War with Egypt, Jordan and Syria, President Sadat of Egypt planned an assault on Israel to re-establish Arab claims on former Egyptian lands beyond the Suez Canal. Syria's President Assad agreed to mount a simultaneous attack on the Jewish state from the north.

At 2:00pm on 6 October 1973 (Yom Kippur Day – the Jewish Day of Atonement), the Egyptians opened an hour-long barrage from 2,000 artillery pieces along their western border. Simultaneously, 240 Egyptian aircraft hit three Israeli airfields and other important targets in the Sinai.

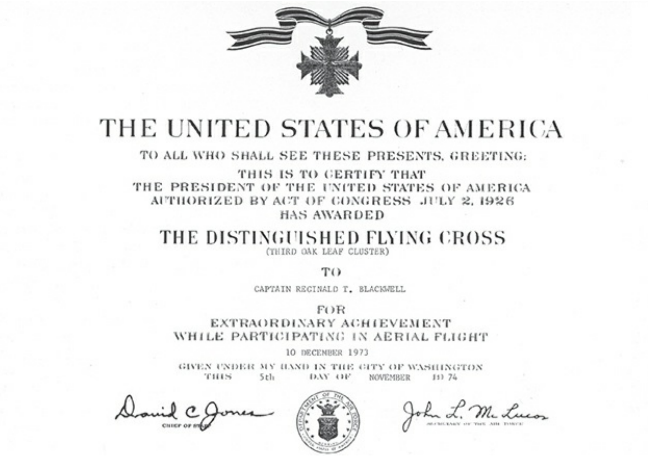
Within 15 minutes the aggressors were advancing along a 130-mile front, employing five infantry divisions supported by three mechanized and two armoured divisions. As Israeli soldiers prayed in their bunkers in celebration of Yom Kippur, the Egyptian war machine rumbled over 10 pontoon bridges that had been thrown across the Suez Canal, stormed the supposedly impregnable Bar Lev Line, and established bridgeheads on the East Bank.

The Syrian phase of the attack opened simultaneously in the north, with another massive 30-minute artillery bombardment. This presaged the advance of three Syrian infantry divisions and two armoured divisions. To coincide with the advance, an independent attack was mounted by Syrian helicopter-borne commandos on the vital Israeli observation point at Mount Hermon in the Golan Heights.

The speed and ferocity of the Arab attack caught the Israelis off guard. Troops were mobilized from synagogues, and Israeli radio broke its traditional silence during Yom Kippur to broadcast instructions to its threatened population. Most Western intelligence agencies were equally surprised by the joint attack. Three days before the Arab onslaught, the Soviets had launched the low-resolution camera-equipped Cosmos 596 satellite from Plesetsk in the southwestern USSR; it allowed them to watch the battle on behalf of their Arab allies.



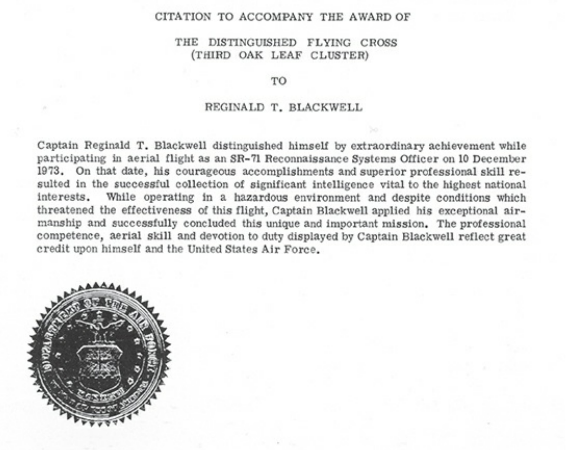
‘964 completed two missions during the Yom Kippur War, one on 11 November and the second on 2 December 1973. (USAF via Dave Peters)



THE UNITED STATES OF AMERICA
TO ALL WHO SHALL SEE THESE PRESENTS, GREETING:
THIS IS TO CERTIFY THAT
THE PRESIDENT OF THE UNITED STATES OF AMERICA
AUTHORIZED BY ACT OF CONGRESS JULY 2, 1926
HAS AWARDED
THE DISTINGUISHED FLYING CROSS
(THIRD OAK LEAF CLUSTER)
TO
CAPTAIN REGINALD T. BLACKWELL
FOR
EXTRAORDINARY ACHIEVEMENT
WHILE PARTICIPATING IN AERIAL FLIGHT
10 DECEMBER 1973
GIVEN UNDER MY HAND IN THE CITY OF WASHINGTON
THIS 5th DAY OF NOVEMBER 19 74

David C Jones
CHIEF OF STAFF

John L. McLucas
SECRETARY OF THE AIR FORCE



CITATION TO ACCOMPANY THE AWARD OF

THE DISTINGUISHED FLYING CROSS
(THIRD OAK LEAF CLUSTER)

TO

REGINALD T. BLACKWELL

Captain Reginald T. Blackwell distinguished himself by extraordinary achievement while participating in aerial flight as an SR-71 Reconnaissance Systems Officer on 10 December 1973. On that date, his courageous accomplishments and superior professional skill resulted in the successful collection of significant intelligence vital to the highest national interests. While operating in a hazardous environment and despite conditions which threatened the effectiveness of this flight, Captain Blackwell applied his exceptional airmanship and successfully concluded this unique and important mission. The professional competence, aerial skill and devotion to duty displayed by Captain Blackwell reflect great credit upon himself and the United States Air Force.

Reg Blackwell was awarded the DFC for his part in the reconnaissance mission flown over the Golan Heights on 10 December 1973. (Reg Blackwell)

The Israelis regrouped within two days and attacked the bridges over the Canal. In the north, the Syrians continued their push towards the River Jordan and the Sea of Galilee. The Soviet reconnaissance effort was strengthened on 8 October when Cosmos 597 was launched; it was able to change its orbit using rockets and despite the resultant increase in the satellite's speed, the perigee improved photographic resolution. Its path, inclined 65° to the equator, aligned it across both fronts. The next day Cosmos 596 was recovered, while the ground situation had turned in favour of the Israelis.

Syrian efforts in the north had ground to a standstill after a furious battle, and Israeli General Sheron's forces in the south had successfully attacked the Egyptians and retaken a second-line fortification that had fallen the day before. The Soviets launched Cosmos 598 on 10 October to improve surveillance of the warzone. Pitched slightly higher than the preceding Cosmos satellites, 598 was already in orbit when 597 returned its film cassettes to earth. The Soviets were also receiving real-time imagery from 598 via the Yevpatoriya tracking station in the Crimea.

As a consequence of the Soviet advantage in reconnaissance, the US decided to step up its intelligence efforts. The SR-71 offered the best hot-spot reconnaissance capability, and plans were drafted to fly missions from Beale to Egypt and recover into Mildenhall. This long-range concept had been validated two years before by the Estes/Vick 15,000-mile test sortie.

General John Meyer, CINCSAC, ordered Col Pat Halloran to prepare for the missions. At that point, Pat knew the sorties would attract wide attention within government circles, and that their success would justify the Senior Crown programme. Due to its importance, he asked the new 15th Air Force commander, Lt Gen Bill Pitts, for permission to 'run the show' himself. At this early stage, the plan was to launch an SR-71 from Beale and refuel immediately after take-off before climbing and accelerating to the next ARCP near Nova Scotia, Canada. A second Mach 3 leg would terminate at a third ARCP off Portugal, before another hot leg to Crete for a fourth AR. The SR-71 would then be flown over the Israeli/Egyptian battle lines before decelerating and descending into the Crete ARCP, followed by another hot leg out of the Mediterranean to refuel again off Portugal before recovering into RAF

Mildenhall, Suffolk, England, after a mission lasting 8½ hours.

Halloran put together a maintenance recovery team and left Beale on a tanker for Mildenhall at midnight on the same day as they alert was given. He later recalled:

> I was scheduled to go straight to London to brief senior MoD officials on the plan, but upon my arrival at Mildenhall I was informed that the British government had had second thoughts and denied us authority to operate from the UK. I was then told that Griffiss AFB in New York State would be our operating location. Without rest we turned the tanker around, and the full complement of planners and maintenance personnel was reloaded for a quick return trip to the US. Undoubtedly that was the shortest overseas TDY in the history of the 9th Wing!

Colonel Pat Halloran was also the initial detachment commander when the SR-71 was deployed to Seymour Johnson AFB, North Carolina, in 1974. Col Don Walbrecht soon took over command of the detachment, however. The aircraft flew missions from the base during the Yom Kippur War. (USAF)

It was alleged that this action was taken by the UK's Tory government, in what ultimately proved to be a futile attempt, to maintain the flow of Arab oil to the United Kingdom – a move that later produced heated exchanges between Europe and the US. However, declassified documents show the claim of Britain's refusal to allow the SR-71 missions to operate from RAF Mildenhall was not altogether accurate. On 8th November 1974 Foreign Secretary James Callaghan wrote to Prime Minister Harold Wilson about US reconnaissance flights over the Middle East. The Americans, he said,

> Approached us in October 1973 with a similar request to use their facilities at Mildenhall…[to which Prime Minister Edward] Heath agreed, but asked for assurances, which the Americans gave, [that]: a) the President [Richard M. Nixon] himself personally approved the flights; b)… the flights and their produce would not be communicated to anyone except [Britain]; [and] c) … the US government were satisfied on each occasion that there was an urgent and important reason for the flight and that the risks involved were minimal.

Callaghan noted that these were the same assurances in the 1971 agreement for SR-71 basing in the UK. In fact, according to Callaghan's 'Top Secret' minute, it was 'the Americans [who] called off the flights', because of what they thought was 'the obvious deep concern in London' and that newly confirmed US Secretary of State Henry Kissinger 'felt that the United States could not use Mildenhall because [the US–UK] agreement [to do so in October 1973] had been given "so grudgingly and reluctantly", although this was not in fact the case.' This was reinforced in a 'Top Secret UK Eyes' 16th November 1973 letter to Sir Alec Douglas-Home, the Secretary of State for Foreign and Commonwealth Affairs. Summarizing a meeting with US Secretary of Defense James R. Schlesinger regarding the SR-71 missions, British Ambassador to the United States Rowland Baring noted that the UK had 'gone out of our way to agree to the US request' but the UK was not willing to share 'material derived from the flights… [with] Israel' due to the British 'policy of strict neutrality.' This was 'assurance b' which Callaghan mentioned in his letter a week earlier. In light of this reservation 'Schlesinger let the matter drop.' No doubt this sharing issue was what Kissinger viewed as Britain's 'grudging reluctance' to approve the missions from RAF Mildenhall.

To complicate matters still further, the Turkish government refused permission for KC-135Q tankers, loaded with the SR-71's JP-7 fuel from storage tanks at Incirlik, to support the missions directly from its country. This forced SRC planners to establish a re-supply system involving tankers repositioning JP-7 from Incirlik to Torrejón, Spain, before they could refuel the Habu.

Before leaving Beale, Col Halloran had instructed Lt Cols Jim Shelton and his RSO Gary Coleman that as the Standard Board (stan/eval) crew they would fly the first sortie. After learning the outline details of the mission and the scheduled take-off time, Jim Shelton had a Seconal sleeping tablet and went to bed that afternoon to ensure he was rested.

During the course of the early evening briefing, Jim recalls being told by the intelligence officer, 'Now don't be surprised if the Israelis or the Egyptians shoot at you because we haven't told anybody you're coming.' It was about midway through the weather briefing that the crew were told that the mission had been cancelled due to the stance taken by the British government.

However, back at the Pentagon, former SR-71 RSO, now SR-71 Program Element Monitor (PEM), Lt Col Ronnie Rice interceded, knowing that Palmdale's flight test SR-71 ('955) was scheduled to conduct a series of evaluations on its new A-2 DEF systems from Griffiss and that rail tankers containing JP-7 to support the test had already been positioned in a siding near the base. The decision was therefore made to base the mission in New York state and fly a round-robin sortie lasting 11 hours 20 minutes. This also had the added advantage of additional support being available from Lockheed's technical field support personnel, and a ready-made cover story for the secret operations over the Middle East.

This group shot was taken after Lt Col Roger Jacks' last SR-71 flight. From left to right, top row, the crew members are John Murphy, Joe Vida, Don Emmons, Al Cirino, Tom Allison, John Fuller, Rich Graham (on own step), Buz Carpenter, Bill Groninger and Bruce Leibman. Standing at the left are Bill Keller, Chuck Sober, Joe Kinego (in the pressure suit to the left), and Roger Jacks. In the bottom row are Jim Sullivan, Jay Reid and Tom Keck. Standing to the right are BC Thomas, Pat Bledsoe (almost obscured) and John Storrie, the 9th SRW Commander. (USAF)

As Col Halloran and his advanced guard set course from the UK back to the

US seaboard, Jim Shelton and Gary Coleman were told to go and get some crew rest ready for the long mission scheduled for the next day. Unfortunately, this wasn't an instruction that Jim was able to comply with, since he was now wide awake after his earlier Seconal-induced sleep. With the amended plan now approved by SAC HQ, Lt Col Jim Shelton and Maj Gary Coleman got airborne from Beale in '979 late on the afternoon of 11 October 1973. Jim recalls:

> As we were told this was a priority mission, the planners had drawn a straight line from the end of our Nevada air-refuelling track straight to the holding fix at Griffiss, not bypassing any of the big towns. It was a clear night and I remember seeing Chicago out of the left window and Indianapolis out of the right. And I said to Gary, 'We're really creating a sonic boom' – as we transited the country at Mach 3!
>
> So we arrive at the holding fix and I'm going through the checklist as we're getting ready to land, about 10 miles out I extended the landing gear and turned on the landing light. But just as I start my flare I said to Gary, 'Oops, the landing light has just burned out.' So I turned on the little taxi light instead. Anyway, when we get out of the aircraft, the base commander is there and he said, 'SAC told me this was a big hush-hush secret mission. You didn't even turn your landing light on until you were over the runway.' I didn't like to tell him that it had burned out and that what he saw was our taxi light!

Once on the ground, Jim made a call to Al Joersz and John Fuller (who would fly a second SR-71 into Griffiss) and advised them to make their descent profile over the Great Lakes to minimize the effects of the boom on the urban eastern states, since there had been a number of public complaints. Fortunately, there were no boom reports when the second crew made their crossing. The next day's newspapers reported a strange phenomenon, which was described by one scientist as a probable 'meteoric shock wave'.

Jim continues: 'The Lockheed maintenance folks took our airplane and parked it at the end of a large hangar. Unfortunately, as they were backing Al's plane in, they didn't have the hangar doors open enough, and it hit the wing tip. So until a new wing tip arrived we didn't have a back-up aircraft.' An hour after the second SR-71 landed, the first tanker arrived, carrying Tom Estes (the operations officer), three mission planners and a number of Beale's best intelligence and maintenance personnel. At 06:00am a secure teleprinter clattered out the final details of the first sortie, which was to be flown 22 hours later.

The first major question to arise when the aircrew met with the mission planners concerned diversionary fields, and no one could offer a satisfactory answer. Later that morning, the Mildenhall tanker [with Colonel Halloran onboard?] arrived, and the unit's technicians began preparing '979 for the longest operational sortie to date. By mid-afternoon someone suggested that the crew should get some sleep, since they had been up for nearly 36 hours and would soon be airborne for another 16 hours during the sortie itself.

Jim went to see the base's flight surgeon for another Seconal tablet, which he finally managed to get after some considerable persuasion. The two were directed to an old Bachelor Officers' Quarters (BOQ), where their room was hot and the beds uncomfortable. Gary Coleman recalled, 'No one could snore like Jim Shelton and I got no sleep at all, but I consoled myself with the thought that my pilot was getting some solid rest!'

For this vital mission, the aircraft was equipped with an optical bar camera in the nose section and two Tech cameras, one in the left, the other in the right chine. The stubbornness of usually helpful allies was causing a real headache, requiring the tanker crews to pre-position JP-7 fuel from Mildenhall and Incirlik to Torrejón in Spain, and the quest for emergency landing sites was proving all but impossible.

Notwithstanding, Jim Shelton cranked '979's engines on cue and lifted off from Griffiss at 02:00am on the first of nine Giant Reach/Busy Pilot missions. He made good the first of six aerial refuellings (two tankers in each AR track) off the Gulf of St Lawrence (Old Barge East). He recalls, 'Over Nova Scotia it was quite warm and turbulent; I hooked up to the tanker and as I started to get heavy the stick-shaker came on a couple of times.'

Having topped off, '979 accelerated and climbed east en route to the next cell of tankers off the coast of Portugal (Rota East). Returning again to speed and altitude, the Habu made a high-Mach dash through the Straits of Gibraltar and let down for a third AR south of Crete (Crete East). Due to its proximity to the warzone and Libya, the US Navy provided a combat air patrol (CAP) with carrier-based aircraft on station in the Mediterranean.

Climbing and accelerating again, the crew coasted in over Port Said. Gary Coleman comments: 'There was no indication of anything launched against us, but everyone was painting us on their radars as we made our turn inbound. The DEF panel lit up like a pin-ball machine and I said to Jim, "This should be interesting".' Jim recalls: 'We lost the lights [ECM warning lights] as we went down south of Cairo and we turned around and came back across the battle area again, making a big "X" over the Sinai. I saw some contrails below me, but I couldn't tell if they were Egyptian or Israeli fighters.'

In all, ’979 spent 25 minutes over denied territory. Entering Egyptian airspace at 1103GMT, it covered the Israeli battlefronts with both Egypt and Syria before coasting out and letting down for the fourth ARCP (Crete West), which was still being CAPped by the US Navy. The next hot leg was punctuated by a fifth refuelling, again off Portugal (Rota West), but the tankers from Torrejón had difficulty getting clearance through the busy airliner-filled offshore airway and only just arrived at the ARCP ahead of the Habu. They could not request a priority clearance because of the secrecy of their mission. When approval was at last received, the air traffic controllers hesitated clearing the tanker cell on its requested track because ‘unidentified high-speed traffic, height unknown’ was approaching from its 12 o’clock position. The tankers could not reveal that the traffic was actually their trade.

Jim recalls that since this was going to be such a long flight, he’d try tube-food for the first time. He said:

> The stuff comes in what looks like a large tube of toothpaste – I decided I’d try the apricot flavour. You had to take the cap off and then screw this other cap on the tube that went through the feed port of your helmet. But of course, this stuff is filled at sea level and our cockpit is pressurized at 26,000ft, so there’s quite a difference in pressurization. So when I break the tube, about a third of the apricot spews out and I’m trying to put it in my pocket so it doesn’t go everywhere in the cockpit!
>
> The other thing I had to worry about during that flight was urine collection capability. We had a little plastic bag that fitted into the pocket of our pressure suit and there was a sponge in it to help it absorb the fluid. Well I had three or four of those, and the first one’s fine, you just put it in your right pocket, because your left one is where your current device is. So what do you do with the third one? I used the canopy emergency ejection handle to my left. I found I could tie the bag there and there was nothing that could poke it, but every time I lowered my seat to refuel I had to put my hand on it to be sure it was clear, then do the same after the AR when I raised my seat – I certainly didn’t want to put a hole in it and leak urine all over the cockpit floor!

Soon after completing his mid-ocean refuelling, Jim climbed and accelerated ’979 back up for his final high-speed run across the western Atlantic towards New York. Mindful of his own fatigue, Gary was in awe of his pilot, who completed a textbook sixth air refuelling (Old Barge West). Jim finally put ’979 back down at Griffiss after a combat sortie lasting 11 hours 13 minutes (more than five hours of which was at Mach 3 or above). This mission even topped the duration record set on 26 April 1971 by Tom Estes and Dewain Vick.

The demanding mission had required support from 14 KC-135Qs, four from Goose Bay, two from Griffiss and eight from Torrejón. Two of the Goose Bay tankers recovered directly into Loring AFB, Maine. The two that had refuelled the mission aircraft over the Gulf of St Lawrence on the first leg flew to Little Rock AFB, Arkansas to take on additional JP-7 before flying to Loring for further staging. Six of the Torrejón-based tankers flew to Incirlik after refuelling the SR-71 and uploaded JP-7 before returning to the Spanish base.

The reconnaissance take was of high quality and provided intelligence and defence analysts with much-needed information concerning the disposition of Arab forces (and Soviet equipment) in the region, which was then made available to the Israelis.

The Syrian military situation was swinging in favour of the Israelis by 14 October. The Soviets had stepped up their airlift of military equipment, but were aware that the Syrian front was collapsing. Washington had begun supporting Israel with a huge airlift of US war materiel. President Nixon had requested $2.2 billion in emergency aid for the Israelis, a request that incensed Abu Dhabi, Libya and Qatar, which had been meeting with oil companies in Vienna since 12 October. They immediately imposed a complete oil embargo on the US, a move quickly followed by the other OPEC oil producers. To further warn nations against supporting Israel, they unilaterally announced a 70 per cent rise in oil prices and a 5 per cent per month cut in petroleum production. The decision caused panic in Western Europe, which depended on the Arab states for 80 per cent of its oil supply.

Meanwhile, in the Sinai desert the Egyptians launched a 100,000-strong offensive toward the east on 14 October, resulting in one of the largest tank battles in history. As Israeli forces gained ground, they also established a bridgehead west of the Suez Canal that threatened to cut off the Egyptian army. With the Egyptian military situation becoming more and more acute, President Nixon announced that US forces across the globe had been placed on military alert following the receipt of information indicating that the Soviet Union was planning 'to send a very substantial force to the Middle East to relieve the beleaguered Egyptian Third Army, now completely encircled in the Sinai.' This tense period in superpower relations was somewhat defused when Soviet Secretary Brezhnev supported a United Nations motion of 24 October that would eventually end the Yom Kippur War.

Meanwhile, SR-71 surveillance missions continued. At 02:00am on 25 October 1973, Majors Al Joersz and John Fuller got airborne from Griffiss in '979 and paid a second successful visit to the Yom Kippur war zone, although after protests from the Spanish government the second and fifth AR tracks were repositioned off the coast of the Azores (out of range of Spanish radars) and renamed Lajes East and Lajes West. Since the US intelligence community was concerned that the Soviet Union might deploy more personnel and materiel to the Arabs, the mission's priority objectives were to monitor the port facilities at Latakia and Tartus in Syria, and Port Said and Alexandria in Egypt.

Additional mission objectives were to determine the extent of the Israeli thrust across the canal and confirm the precise location of the Israeli, Egyptian and Syrian fronts. The SR-71 was therefore required to photograph an area 20nm west and 10nm east of the Suez Canal.

Sixteen KC-135Qs supported this second mission. The first and last ARCPs were moved from the Gulf of St Lawrence to an area south of Nova Scotia and covered by four tankers re-deployed from Griffiss to Loring.

A third mission, scheduled for 2 November 1973, was postponed due to poor weather over the target area and instead flown, again by '979, on 4 November. Maj Bob Helt and Maj Larry Elliott secured more photography of the ports for national intelligence users, and also covered Cairo international airport and the Tura cave facilities near Cairo, which, it was believed, might contain Soviet 'Scud-B' mobile missiles. The mission lasted nine minutes longer than the previous two, establishing an SR-71 endurance record of 11 hours 22 minutes.

Maj Jim Wilson and Maj Bruce Douglas took '964 on its first sortie to the Mediterranean on 11 November. The ten-hour 49-minute flight departed Griffiss and terminated as planned at Seymour Johnson AFB, North Carolina. The reason behind the detachment migration to the south was to avoid the New York winter weather. Col Don Walbrecht headed the new detachment, which had been pre-arranged with HQ TAC by Col Harlan Hain from the SAC Reconnaissance Center.

Of the four KC-135Qs at Loring, two supported the SR-71 in the first air-refuelling track before recovering back. Three then departed to join the 13 Q-birds at Torrejón, while the fourth flew to Griffiss, picked up maintenance and staff personnel, then positioned them to Seymour-Johnson AFB.

To enable more timely analysis of the mission data, SAC received authority from Headquarters USAF to move portions of the SR-71 Mobile Process Center from Beale to Seymour Johnson, a task accomplished with the assistance of a C-5A and a C-141 on 12 November. It was operational just 92 hours later. The move reduced the number of air refuelling tracks from six to five, despite the distance being much the same. In fact, the more southerly base enabled the

SR-71 to cruise longer at supersonic speed on its return to the US, rendering it more fuel efficient.

Since the shooting war was over, SR-71 reconnaissance was now used to demonstrate compliance with the ceasefire agreement and provide irrefutable evidence for newly confirmed Secretary of State Kissinger's team, which was leading the delicately balanced withdrawal negotiations between the deeply distrusting Israelis and Arabs.

Fierce fighting broke out along the ceasefire line on 30 November and threatened to destroy the fragile agreement brokered by the US. Jim Sullivan and Noel Widdifield flew '964 across the Atlantic on 2 December 1973, to look at the situation. It proved to be a well-timed move, as fighting had begun that same day in the Golan Heights. Further diplomatic pressures put an end to the new skirmishes before Pat Bledsoe and Reg Blackwell went out in '979 on 10 December for another look at the belligerents. They flew a 'clockwork' ten-hour mission, arriving back at Seymour Johnson 'on the minute' of their flight plan. Things were quiet for the next five weeks, so the Beale troops went home for Christmas. In January they returned to base to carry on with Sinai surveillance activities.

Skip Holser, a Sgt at the time, recalls the demands faced by maintenance teams supporting the SR-71 operation at Seymour Johnson AFB,

> On one occasion, for 2 or 3 nights straight, we pre-flighted, serviced, etc. two SR-71s ready to fly a particular mission. One aircraft was designated primary to fly the sortie, the other was the backup all set to be launched if primary air aborted due to a problem.
>
> So picture two SR-71s each fully loaded with its camera, sensors, fuelled with 65,000lb plus of JP7, 212 litres of liquid nitrogen (LN2) on board, TEB, tire checks done. Map projectors loaded. The ANS all aligned. Buick start carts hooked up as is the aircraft's external power and air conditioning. Everything is set. Pre-flight completed and signed off. We were just waiting for the aircrews for a midnight take-off and noon recovery.
>
> Then we got the call, 'mission cancelled' – Kissinger is in the process of peace talks!
>
> So we now had to defuel 25–30,000 pounds of JP7 fuel from each aircraft which first required relieving the nitrogen fuel tank pressure to slow the fuel leaking.
>
> This meant that a total of 424 litres of LN2 was wasted. We drained the dewars into metal trash cans and once full either let them boil off or found a good spot to kick them over. We then called for two empty fuel trucks – one for each jet and defuel down the 40,000lb remaining onboard. Getting the fuel out of tank 3 below the wing line and all the fuel out of tanks 6 A and B in the aft inboard wings first, since they leak the most.
>
> We ended up repeating this whole process for the next two nights while Kissinger was in the process of peace talks!

On 25 January 1974, Majors Buck Adams and Bill Machorek flew another perfect ten-hour sortie, but they returned to Seymour to face a very low ceiling and visibility that mandated a diversion to Griffiss. This would put the 'take' out of position for processing. Don Walbrecht said: 'We had Buck grab some fuel from the standby tanker and "jacked the ceiling up a bit" (against the complaints of Harlon Hain at SAC Headquarters) and Buck snuck in to a perfect landing at Seymour under the lowest ceiling an SR-71 has ever landed.'

The detachment's spirited 'high jinks' (after each outstanding mission of recognized national importance) annoyed the 4th Fighter Wing Commander, Col Len Russell, whose fuel stocks had been quickly depleted by the five KC-135Q tankers that supported the SR-71 movements. With a serious shortage of fuel throughout the war, Seymour Johnson had not been resupplied for fighter training sorties. To further complicate matters, Beale's new 14th Air Division commander, Brig Gen Don Pittman, really messed things up by demeaning Col Russell, who was embittered by what had appeared to be SAC 'heavy-handedness'. The fuel embargo imposed by the OPEC nations caused the Air Force to husband its fuel supply and drastically reduce other flying to currency rides only. Because of Russell's complaints to his TAC boss Gen Robert J. Dixon, headquarter's SAC arbitration was necessary to put things back in perspective. SAC's Deputy Chief of Staff for Logistics came to Seymour Johnson to thank Russell for supporting the Sinai effort and to solve his fuel problem. Within a few days, the pipeline flowed with JP-5 for the TAC F-4s and a trainload of JP-7 arrived for the two SR-71s.

The success of international peace efforts soon began to show. On 18 January 1974, a military separation agreement was signed between Egyptian and Israeli defence officials that led to troop withdrawals. By mid-February, the Middle East peace process was beginning to go into 'overdrive' and on the 18th, four Arab nations proposed a truce in the Golan Heights.

To verify the pull back, '971 was dispatched to the Suez on 25 January. There had been a great deal of suspicion on both sides that the opposing forces would not pull back; the Habu's photography became the instrument of verification and was shown at the peace negotiations as proof. With the evidence in hand, full diplomatic ties were finally restored between Egypt and the US after a break lasting seven years.

As troop withdrawals continued, Majors Ty Judkin and Maj George 'GT' Morgan flew '979 on the next to last long sortie. Appropriately, this apparently evergreen aircraft also flew the final sortie on 6 April 1974. In total, it had flown two-thirds of the nine ‘10-hour’ sorties, chalking up a remarkable rate of success, despite their very demanding nature, without ground or air aborts or diversions.

Those nine long flights represented a pinnacle of operational professionalism. They were a tribute not only to the dedication of the aircrews, but also to that of the staff planners and the small group of top ground technicians who maintained the SR-71s away from home. These sorties also stood as a testament to the long reach of the aircraft and its ability to react quickly to world events.

However, they placed considerable strain on existing SR-71 operations, especially since Headquarters USAF had decided to cut the number of primary authorized aircraft (PAA), from eight to six with effect from 1 July 1973. The JCS therefore tasked the SRC to undertake an evaluation of Senior Crown’s overall operational effectiveness. The SRC concluded that the Mediterranean photo-reconnaissance mission had: ‘Severely degraded the ability of the 9th SRW to maintain currency and crew proficiency for non-combat ready crews.’

As a result, on 12 January 1974, Secretary of Defense James R. Schlesinger gave formal approval to restore the number of PAA SR-71s back to eight A models with effect from 1 July. Consequently, ’976 and ’975, which had been in storage at Beale, were returned to operational status, and ’975 was positioned to Lockheed Palmdale, where it became a functional flight test aircraft. To support the enlarged fleet, nine more officers and 64 additional enlisted personnel were recruited also into the programme.

SIMULATOR TESTS

Capt Maury Rosenberg and another Air Force pilot were instructed to report to the General Dynamics plant at Carswell AFB near Fort Worth, Texas, in May 1976 to help in some research. The two officers were directed to an obscure room in the plant containing two very crude cockpits equipped with a stick, throttles and basic flight instruments. The room was a web of electrical wiring connected to racks of monitoring apparatus and a computer. The aircraft’s ‘capability’ was Mach 3.0 at 100,000ft with no simulated armament. The other cockpit was similar, but it also had a radar, a fire-control panel and ‘carried’ missiles.

Two basic intercept profiles were flown. The first began with the missile-equipped interceptor scrambled from an alert pad when the unarmed 'aircraft' was detected 350nm away, and a repeat was flown when the target was 450nm away. In the second profile, the missile-equipped aircraft was in an airborne race track pattern. As the unarmed aircraft entered the area, the interceptor was vectored inbound on various intercept angles – head-on, abeam and tail-chase.

Four engineers monitored readouts as the scenarios were played out and would stop the proceedings to reset their instrumentation when they changed from one vector to another. It was dull, time-consuming work in which only 12 intercepts were to be completed in a full day. The engineers asked the pilots lots of performance questions to help verify some relevant flight data that they already gleaned from another source. It did not take long to abandon the scramble profile and concentrate on an orbit-vector profile. Pat Bledsoe repeated those 'simulator flights' two weeks later. One of the other pilots involved in the tests was Maj Bob McConnell, who later became an air attaché in Moscow. It's highly likely that these tests were designed to evaluate how an SR-71 would perform against the perceived threat of the Soviet's MiG-25.

Just four months later on 6 September 1976, Soviet pilot Viktor Belenko defected from Siberia to Japan in a MiG-25P. During his CIA debriefing, he talked about how he was trained to shoot down an SR-71 near Vladivostok, and how the Soviet controllers and pilots had reached the conclusion that their best chance to make an intercept would be achieved by being airborne in a holding pattern that faced the track of the high flyer. He admitted that experience against other 'Foxbats' showed that the prospect of getting an SR-71 was quite remote, unless one carried a 'nuke' intercept missile.

RECORDS

In 1976, SAC and HQ USAF agreed to show some of the SR-71's capabilities as part of the nation's bicentennial celebrations. The original plan was to set an 'around the world at the equator' speed record. Pat Bledsoe and John Fuller were the senior crew at that time and were chosen to make the flight. Initial planning showed that it could be done in 16 hours and 20 minutes with seven refuellings.

The only modification required for the SR-71 would have been an additional liquid nitrogen dewar for fuel-tank pressurization.

The crew were sceptical of their own physical limitations for a flight of that duration, but believed that adrenalin would probably keep them going. Pat recalled: ‘Preparations proceeded well until the full plan reached HQ USAF. When the generals saw the cost of deploying the fuel and tankers to forward bases they were aghast. It would take nearly 100 KC-135 flights to carry out the operation safely. The word came back to Beale to “do something more reasonable”.’ Consequently, the 9th set a new series of world speed and altitude records on 27 and 28 July 1976 (see Appendix 11).

INTEREST FROM THE US NAVY

To cut defence expenditures, Soviet Premier Nikita Krushchev was initially exclusively reliant upon the nuclear deterrent. However, the Cuban Missile Crisis of 1962 convinced many Soviet leaders that Soviet foreign policy, unsupported by a strong conventional capability, was extremely vulnerable. The proposed strategy of building a small coastal fleet was overthrown by Krushchev and following the appointment in 1964 of Admiral Sergey Gorshkov as the head of the Soviet Navy, the Soviet Union began to build a large, flexible ‘blue water’ navy that remained submarine centric. It was divided into four major fleets: the Soviet Northern Fleet, Soviet Pacific Fleet, Soviet Black Sea Fleet, the Soviet Baltic Fleet and under separate command, the Leningrad Naval Base.

US Navy planners believed that if war erupted within the European Theatre of Operations (ETO), the Soviet Navy would challenge the United States on the high seas by using its attack subs to threaten the vital sea lines of communication (SLOCs), used by merchant shipping, just as the German U-boat fleet had done in World War II, thereby forcing the US Navy into a defensive role.

However, to reach deep water the Soviet Navy had first to overcome some fundamental geographical constraints. For example, if Soviet forces wished to sortie against NATO’s SLOCs in the Atlantic, they’d need to route around Norway’s North Cape and travel southwards down through the Greenland–Iceland–United Kingdom (GIUK) gap. Another possible alternative was to route through the narrow and shallow waters of the Baltic Sea’s western exits, or out of the Black Sea through the Turkish-controlled Bosporus and into the Mediterranean, which was even more confining. In the Pacific, vessels leaving Soviet ports were less restricted, but would still need to deal with surveillance and naval forces based in Japan and the Aleutian Island chain. In Europe, therefore, US naval planners were particularly interested in monitoring naval activity in the five naval bases at Zapadnya Litsa, Vidyayevo, Gadzhievo, Severomorsk and Gremikha (home of the Northern Fleet).

Leveraging the geographical constraints to full advantage, in the late 1950s the US Navy developed a Sound Surveillance System (SOSUS). It used underwater, passive acoustic-detection devices able to pick up the low frequency sounds radiated by vessels, sending such data via cables running on the seabed to one of six US Navy shore-based processing facilities for analysis. With every vessel having a unique acoustic 'fingerprint' the US Navy collected a vast library of acoustic characteristics, or acoustic intelligence (ACINT).

By the mid-1970s, the Navy Ocean Surveillance Information Center (NOSIC) at Suitland, Maryland, had developed a computerized database that matched specific sound characteristics with individual oceangoing vessels and submarines – a process known as hull-to-emitter correlation (HULTEC). Using ACINT and other monitoring systems, US naval intelligence was therefore able to monitor the comings and goings of Soviet missile-carrying 'Golf ', 'Hotel' and 'Yankee'- class submarines as they transited from their home ports to and from their patrol areas off the US east and west coast seaboard.

Under the leadership of Admiral of the Fleet of the Soviet Union Sergei Gorshkov, the Soviet navy became a powerful blue water fleet, capable of projecting power outside Soviet home waters and challenging Western naval power. In 1973, the Soviet Navy commissioned their first 'Delta'- class nuclear-powered ballistic missile submarines (SSBMs, or 'boomers'). Depending on the specific variant, 'Deltas' carried between 12 and 16 R-29 submarine launched ballistic missiles (SLBMs). Armed with a single 1.5Mt nuclear warhead, the R-29 touted a range of 4,780 miles and were capable of hitting numerous targets within the United States.

By the spring of 1978, a group of young analysts at the Office of Naval Intelligence (ONI) had become aware of a drop in ACINT in what appeared to be a fundamental shift in Soviet naval strategy. With the 'Deltas' now in service, it seemed increasingly likely to these analysts that instead of running the gauntlet of SOSUS arrays positioned at known choke points, the Soviet Navy was instead intent on establishing the Barents Sea and areas off Vladivostok and Petropavlovsk as highly defended ‘bastions’ that were effectively no-go areas to US or allied naval forces. From these year-round ice-free safe havens, the Soviet SSBM fleet could fire their lethal nuclear missiles at targets within the United States with relative impunity. This doctrinal protection of the Soviet submarine fleet sought to preserve a favourable correlation of forces at the end of any initial nuclear exchange.

Understanding this new Soviet naval strategy resulted in the US Navy responding by developing the so-called Maritime Strategy. This sought to make victory possible in a war against the USSR in three principal ways: by destroying as many SSBNs as possible, thereby reducing the nuclear threat to the United States; by launching strikes on Soviet targets from US carriers; and by tying down the Soviet fleet in static defensive operations in the far north, thereby preventing it from causing mischief elsewhere. This aggressive forward-focused naval strategy would also, it was hoped, prevent Soviet naval aviation from bolstering support of ground forces intent on any offensive operation in Europe.

However, essential to the Maritime Strategy’s viability was a requirement for the ONI to have an accurate 24/7 fix on the position of every Soviet SSBM. This would require the frequent and regular surveillance of northern Soviet naval ports from where these powerful subs were located; a particularly difficult task – even for satellites.

THE BARENTS, SATELLITES AND THE SR-71

Equipped for collecting either high-resolution radar or photo imagery, the most advantageous orbit for a recon satellite, tasked with collecting imagery from extreme latitudes is a polar sun-synchronous orbit. This passes over, or close to the north and south poles and is capable of imaging the entire globe once a day, as the earth rotates below it. A pass over the polar regions occurs approximately once every 100 minutes. This means that the satellite will always pass over the same location of the earth at the same local time, making imagery comparison easier. The orbit sits between 600km– 800km above the earth’s surface – considerably lower than a geostationary orbit, thereby increasing imagery resolution.

The problem facing this method of collection is that the differing orientations of the subs' protective pens, relative to the satellite's track, makes it almost impossible to establish whether all the pens are occupied or not as it passes overhead. This is coupled with the prevailing weather conditions, which for the most part consists of persistent cloud cover, rain and fog; and of course, the long, dark Arctic winters present innumerable issues for US recon satellites. Even on clear days, the sun's angle over the Barents Sea was often too low for the collection of high-resolution photography due to its reflection off the sea's surface. However, an SR-71 flying a series of turns in international airspace, in excess of 75,000ft and equipped with a High-Resolution Radar (HRR), aka its Capability Reconnaissance Radar (CAPRE), provided solutions to virtually all the problems faced by satellites.

Aware of the SR-71's HRR capabilities, in May 1978 Admiral James A. Holloway III, Chief of Naval Operations (CNO) requested that the Defence Intelligence Agency (DIA) validate a requirement to use the aircraft as a platform for gathering naval intelligence. The request proved to be the beginning of what became a vitally important commitment, for both the Senior Crown programme and the US Navy.

The DIA's evaluation indicated that seven such missions per month would be needed to fulfil the Navy's requirement, but it recommended that the SR-71 should first fly several evaluation sorties. In 1978 the number of PAA aircraft stood at eight, and with commitments in the Western Pacific, to the

The US Navy utilised the SR-71's HRR and, when weather conditions permitted, its close-look TEOCs to monitor the comings and goings of the Soviet nuclear ballistic missile equipped submarine fleets. Pictured is a Delta-class boat equipped with up to 16 ballistic missiles, each with multiple warheads. (HUM Images/GettyImages-1371356416)

SIOP, the Strategic Projection Force, the two or three annual deployments to Mildenhall and training operations at Beale, it was thought that the level of coverage required by the CNO was beyond what was possible with the number of funded aircraft available, so the matter was put on hold. However, in support of a SAC worldwide nuclear readiness exercise entitled Global Shield '79, an SR-71 round robin mission from Beale into the Barents Sea and back was flown on 13 July 1979, by Majors Joe Kinego and Bill Killer. Joe recalls, 'It was 10:45 hours long and involved five refuellings. I remember we turned around the following week and flew '972 to Kadena in 6.4 hours, I remember my butt was still sore and tired!' The mission was extremely successful and obtained high-resolution radar imagery of the targeted area. It was followed up by two further round-robin missions from Beale in 1980, one of which is now described by Buz Carpenter.

BC Thomas (left) and RSO Jay Reid recovered into Fairchild AFB on 17 May 1980 ready to participate in the base's open house. (USAF)

At around midday on 15 May 1980, my RSO Chuck Sober and I were alerted that we would shortly be tasked to fly from a long-duration, special mission from Beale and into the Barents Sea and back. We were advised to keep our activities unchanged and that we would be informed when the planners were ready for us to review the mission. It was a real challenge for the planners, who were scrambling to plan this mission and the tankers were already being deployed to Pease AFB, New Hampshire, in preparation for the planned east coast refuellings.

We and fellow HABU crewmembers, pilot BC Thomas and RSO Jay Reid (who were to be our airborne backup crew) were instructed to attend a planning meeting at 7:00am the next morning in the secure intelligence vault, to review the mission. The planners had worked all through the night to complete this complicated mission that had two main purposes. First and foremost, the intelligence collection in Murmansk and secondarily, if possible, to support the Fairchild AFB Open House, to which the wing had already committed.

The plan called for Chuck and I to take off at 10:00pm on Friday night, 16 May, refuel, climb, accelerate and head East, across Canada at Mach 3.0, to Goose Bay, Labrador, for a second refuelling.

At 11:00pm BC and Jay would take off, complete an air refuelling using the same tankers we had used and await a call about the status of the primary aircraft. If the primary aircraft was 'Ops Normal' and heading across the Atlantic, BC and Jay would complete a training route and recover into Fairchild AFB. If we could not proceed, BC and Jay would replace us and depending on our aircraft's status, we would try to make it to Fairchild AFB.

To be able to supply the fuel needed, three tankers would be located in each refuelling track. Refuelling track one was over Utah and Idaho and both SR-71s would take fuel from them. The refuelling track at Goose Bay might involve both aircraft if I had to abort. Refuelling track three, called Viking North, would refuel the mission aircraft going to Murmansk – the objective area, and would be the fourth refuelling for this aircraft having completed the intelligence runs, as it headed west, back to home plate. Refuelling track five, back over Goose Bay, might have refuelled two aircraft already (if I aborted after refuelling at Goose Bay when outbound), and would now be making a third aircraft refuelling.

Maintenance technicians begin to remove coverings placed over intakes, ready for '971's return flight to Beale. (Bill Campbell via BC Thomas)

With both J58s now 'turning and burning', BC Thomas and Jay Reid gingerly taxi '971 towards Fairchild's main runway. (Bill Campbell via BC Thomas)

Once the mission planning was complete and we'd had an early lunch, we all headed to the Physiological Support Division facility, to spend the night in sound-proof, aircrew rest rooms, where we would not be disturbed. We'd been tested for special sleeping pills to assure their effectiveness and that we would awaken refreshed. After taking the pill, I dropped off to sleep rapidly.

We were awakened at around 7:00pm, the pre-flight physicals were administered and the complete operational briefing presented. Our tankers were all in place, weather enroute looked good, both aircraft were prepared and ready, and there were no last-minute unusual threat concerns as we were staying in international air space. After our meals of steak & eggs we were suited up and delivered to our aircraft about 50 minutes before takeoff. Our aircraft was '958 and I cranked the engines, taxied out and got airborne exactly at 10:00pm.

Our initial refuelling took place over Utah and Idaho, before our acceleration and climb took us over Canada. Refuelling number two was heading due east and the sun had not yet risen, which made the refuelling a lot easier than normal. With '958 fully functioning, we called Operations normal and climbed and accelerated east over the Atlantic. BC and Jay Reid executed their training route in '971 and recovered, as planned, into Fairchild early Saturday morning.

Our third refuelling was north of the Arctic Circle and north of Norway, in a refuelling track called Viking North. The three tankers had come north out of RAF Mildenhall. Again, all was normal with the refuelling, acceleration and climb. We initially levelled off just below 80,000ft at 3.15 Mach and established a cruise climb configuration while passing just north of the Soviet's Union's northern international boundary, while imaging Murmansk's naval facilities, particularly the submarine pens, using our synthetic aperture radar. A turn to the north takes us on a parallel path to Novava Zemlya, followed by a counter-clockwise turn to the west, and followed by a turn to the south, heading directly back at Murmansk, before making the final turn to the west. We knew on our initial pass it was a particularly cold day, as we were leaving a contrail above 80,000ft and it had attracted Soviet MiG-25 and MiG-23 fighters trying to intercept us. Flying back through our almost exact same flight path gave a whimsical sense as we were flying through our own contrails – we'd contrailed all the way around this area, clearly identifying our presence. Once clear, we descended and refuelled again in Viking North before heading west across the Atlantic, racing the sun, trying to get back into the dark

> night where we had started. Our fifth refuelling went as scheduled, but our Liquid Nitrogen (LN2), used to inert our fuel tanks, was getting rather low, even though we were carrying an extra LN2 auxiliary tank. We arrived back at Beale, for an uneventful recovery. We could not have done another hot leg, as by this time our liquid nitrogen was gone. In a rare occurrence with my family being involved, as I was slowing to taxi speed, the wing commander pulled out in front of the aircraft and in the car back window I could see the smiling faces of my three daughters – Priceless! The mission was a total success and in recognition, we were each awarded Air Medals.

AT FAIRCHILD AFB

Meanwhile, back at Fairchild AFB, a series of unforeseen events began to unfold. On Saturday 17 May 1980, a T-38 flown by Lt Col Randy Hertzog and RSO Maj Bill Keller arrived from Beale together with a KC-135Q tanker carrying fuel, start-carts and support technicians, ready to assist in the recovery and later launch of '971. BC and Jay arrived at the Washington State base in the early hours of Sunday morning and all was made ready for the Open House event, later that day.

However, Mother Nature had other ideas and following a series of phreatic blasts from the summit of Mount Saint Helens, some 260 miles to the southeast, a major, explosive eruption took place at 8:30am. BC and Jay recall,

> We heard of the eruption while eating breakfast at Base Ops, just before the air show was officially to begin. We went to the flight line and stood in front of the aircraft as per usual, dressed in our navy blue, air show dress flight suits and greeted the crowd for about 30 minutes. On the horizon, we could see what looked like a giant thunderstorm building and beginning to block the sun as very fine ash started to fall; it floated like snow, but smelled slightly of sulphur and other pollutants. Shortly afterwards an official car began driving slowly up and down the ramp, announcing through loud speakers, that the air show was cancelled and directing several thousand spectators to *please leave the area*. Several of the privately owned display aircraft started to crank their engines and prepare to depart. Some actually begin to taxi toward the runway, while a significant number of spectators were still present on the tarmac, making their way toward the exits. We didn't observe any close calls, but it was a surreal scene.
>
> By midday, the ash approaching was like that of an arcing sunshade from horizon to horizon, being pulled across the sky overhead (dark, almost black sky behind and blue bright sunshine sky in front). Chief Campbell and his team had taken full charge of the aircraft and mindful of the possible corrosive elements present in the volcanic ash that might attack the aircraft's titanium surfaces, ensured that it was safely secured in a hangar.
>
> By 2–3:00pm, the sky was completely black, just like it was midnight on a moonless night, with no ground 'light pollution' – it really was pitch black. We, along with a large crowd, filled the Officers' Club and gathered around the bar, and with lights that continued to operate, drinks arounds were in fashion. The rain of ash did not abate until well within nightfall – real nightfall. Jay and I stayed in the O' Club until around 2:00am, when we went back to our rooms in the transient officers' quarters.

Trudging through the ash was messy, because it was so light and thick, maybe by that time 3–4 in. (and with drifts); the wind and the force of stepping caused billowing. By morning, the sun was shining, the ash fall had stopped, but the pungent odour persisted. We had to improvise breathing masks when outside, and of course, we kept our windows and doors closed.

'971's progress during take-off is marked by a trail of volcanic ash. (Bill Campbell via BC Thomas)

We visited '971 daily, but we did not actually work on it. It was in a closed hangar, so it escaped the brunt of the ash fall, but the ash was so fine that a goodly amount had found its way into the hangar and on to the airplane. Cleaning the ash required clean, wet towels or rags, which got dirty very quickly.

With the agreement of Col Randy Hertzog, we modified some of our procedures to minimize ash ingestion when it came time to depart. That time finally came on 23 May. We wore pressure suits in accordance with SAC regulations, and overshoes, so that we could remove them (and the ash), before stepping into the cockpit. Starting engines was normal, but taxiing was followed by a cloud of ash behind the engines, so I never advanced the engines from idle until on the runway. Our normal engine run-up was omitted, and I performed the check as I advanced the throttles for take-off. There was quite a cloud of ash-dust kicked up on take-off. We'd also made the decision to delay turning on the aircraft's air-conditioning systems until we were above 10K altitude. This meant that we were without cooling air to our pressure suits from the time we stepped into the aircraft, throughout engine start, taxi, take-off, and departure – so we did get quite warm until we turned on those systems passing 10K ft. The subsonic return flight to Beale was without incident.

DIVERT TO BODØ

Not all SR-71 round-robin flights originating from Beale AFB to monitor the Soviet Northern Fleet on the Kola Peninsula were flown as planned, as BC Thomas now recalls.

My RSO, Jay Reid, and I were assigned this mission scheduled for Wednesday 12 August 1981 in SR-71 aircraft '964. We reported for the flight at 7:00pm, checked weather and last-minute changes to the mission requirements, updated the intelligence briefing, met with the mobile crew and SR-71 crew chief, ate a meal of steak and eggs, donned our space suits, conducted an aircraft pre-flight, and were ready for a 9:47pm take-off. The flight profile called for a 45,000lb take-off fuel load; a rendezvous with two tankers over Idaho to fill our tanks; acceleration to Mach 3+ while cruise-climbing to 80,000ft; descending to 26,000ft to meet more tankers over Goose Bay, Labrador; crossing the Atlantic Ocean just south of Greenland and Iceland at Mach 3 to a third refuelling over the North Sea, northeast of Scotland.

The next acceleration was to Mach 3.25 to penetrate the Soviet air defence region around Murmansk. Passing west of Norway, then north of Finland, we headed toward the Soviet coast by flying inbound from a point in the Barents Sea and approaching the land mass at Murmansk directly at 90° head-on.

There is no doubt that our presence was heralded to Soviet personnel on the ground by the sweet (and rather loud) sound of freedom: the distinctive triple-sonic boom of the 2,200mph SR-71. That knowledge would always give us a certain inward sense of pride; not in ourselves altogether, but pride in the aircraft, the engineers and designers who built her, the maintenance people who made her safe to fly, and the faithful tanker crews who were always there when we needed fuel. All of these support personnel were vital for any successful mission.

The local Norwegian newspapers soon got wind of BC Thomas and Jay Reid's emergency divert into Bodø with '964 … much to the concern of the base's commander General Aamoth. (BC Thomas)

The Soviet Union claimed their sovereign territory extended 100nm from their landmass. The international norm is 12 miles. Heading inbound, we turned so that we flew within 12.5 miles of the Soviet coast in a 30° right-banked turn while obtaining radar imagery (or photographs) and recording Soviet electronic countermeasures. This somewhat provocative technique was 'trolling' – we stimulated the Soviet defences, causing their radios and radar to bristle with electronic information, thus impelling them to reveal tell-tale electromagnetic signatures indicating the type of equipment, modes of operation, and limits. There were sometimes other American assets offshore, but within radio range, which also collected electronic transmissions.

After departing the take area, the plan was to refuel again over the North Sea, accelerate to Mach 3, refuel for a fifth time over Goose Bay, then fly Mach 3 thereafter to Beale AFB. We planned to land at 8:15am on 13 August, after 10.5 hours of very intense flying.

We were operating a long distance from home base, the mission was deemed vital, and no crewmember ever wanted to abort a flight. Any mission deviation could easily lead to an international incident, would be scrutinized by the highest National Command Authority, and possibly result in our names appearing in every major newspaper in the world. We certainly felt this responsibility, but had the utmost faith in our preparation, training and the talent and dedication of all our support branches.

After transiting Murmansk and while hooked up with the tankers during the fourth refuelling, I saw a flicker of the master warning light. Jay Reid announced the light at the same time that I saw it in my peripheral vision. I disconnected from the tanker's boom and manoeuvred back to the pre-contact position. Our indication was the illumination of the left engine oil supply low-quantity red warning light. From our training and experience with the aircraft emergency checklists, we knew immediately that this required that we 'land as soon as possible'. The mandate to land immediately was borne out of long experience with malfunctions, the type that would crash the airplane if another single system failed.

The natural tendency for military aircrews is to complete the mission if humanly possible. To counter this inclination, the wing commander had designated certain emergencies sufficiently critical to require immediate landing. This was one of those emergencies.

Our mission planning and alternate airfield study had prepared us to know quickly where to fly if an emergency required immediate landing. Some military intelligence might limit our choice of a suitable landing field, depending on the political situation, and of course weather was always a major consideration. Jay and I quickly agreed that recovery at the joint civilian/military air base at Bodø, located on the Norwegian coast a few miles above the Arctic Circle, was best. We were about 60 miles away.

We wasted no time notifying the tanker crews of our decision to land. They set up a holding pattern in international airspace to assist in refuelling, or to be our radio relay if necessary. Their standing orders were to await our call to release them, presumably after our safe landing.

While Jay was transmitting our mandatory abort reports via high frequency, long-range radio, I contacted Norwegian Approach Control. Our orders were not to broadcast that we were flying an SR-71, but rather give the general type as 'US Air Force Tactical', which really meant nothing to a controller concerned about arranging for emergency equipment and notifying proper authorities of our emergency condition.

My call sign was 'Belmont 86' and my transmissions to approach control were something like this:

Bodø Approach, Belmont 86, six-zero miles west, declaring an in-flight emergency, request straight-in approach to land on runway zero seven.

Belmont 86, say aircraft type, nature of emergency, souls on board, and fuel remaining.

Bodø Approach, Belmont 86, US Air Force Tactical, engine problem, two souls, zero plus four-five fuel on board.

Belmont 86, say again aircraft type.

Bodø Approach, Belmont 86, US Air Force Tactical.

Belmont 86, I do not understand your aircraft type.

This is Belmont 86, we will land in approximately 10 minutes and I will deploy three drag parachutes: two small and one 40ft 'chute. I will jettison all three on the runway. I don't have time now to talk.

We were cleared to land with nothing more said. We touched down at Bodø on August 13, 1981 at 1:12pm (Norwegian time) after a total flight of 6.4 hours. When we were on short-final approach, tower controllers had no problem identifying our aircraft type, and immediately sent out notifications, which, we learned later, included the local press.

What could we expect? What kind of reception would the Norwegians give us and would the airplane be secure, especially considering that we had on board highly classified images and electronic recordings from Murmansk?

I asked for and was given taxi directions to the Norwegian military ramp, where I could see some friendly looking F-104s, the frontline NATO fighter aircraft. After I shut down the engines and we opened our canopies, the first person to greet us was a Norwegian military pilot who said: 'Welcome, do you know Bill Groninger?' Bill Groninger was a fellow SR-71 pilot who was a USAF instructor pilot before he was chosen for the SR-71 programme. The Norwegian pilot was his student. We learned that many Norwegian fighter pilots received their initial training in the USA. We definitely were among friends!

We were quickly introduced to General Olav Aamoth, the wing commander at Bodø. He asked for any special requirements and I requested full-time guards be placed on the aircraft, with only myself and Jay Reid authorized to admit personnel to the plane. He agreed and assured us that the aircraft would be guarded continuously. I then asked for a secure phone to call the command post at Beale AFB.

General Aamoth drove us to an underground labyrinth of tunnels carved into the side of a mountain, containing maintenance shops and aircraft. He directed me to a telephone within his command centre. I called the 9th SRW commander, told him the time of the abort and that operations were normal up to the emergency, thus relaying that we had the reconnaissance data on board. This information was needed to arrange for the proper retrieval of the mission materials. We briefly discussed the nature of the emergency, and I assured him that the aircraft was safe. He said that we were to stay there until the aircraft was repaired, which would probably take three days. The 9th SRW had already started a recall for the support personnel necessary for the recovery of the SR-71.

General Aamoth seemed unusually concerned, as he insisted that a Norwegian officer physically be present with us until we left. He introduced us to an F-104 pilot, 1Lt Roar Strand, who would help us with anything we might require. He was a very pleasant guy and I kind of felt sorry for him because I was sure he had better things to do than to ‘mind’ us for three or four days.

Roar Strand was very accommodating. After all the immediate activities associated with bedding down the aircraft were accomplished, he took Jay and me to his apartment, where we met his beautiful girlfriend, then to a restaurant in downtown Bodø, where we spent a pleasant evening.

Beale was the SR-71’s home base, where aircraft, crew, support staff and their families were stationed. ‘Team Recce’ was also very much about the other mission-critical aircraft based there – the KC-135Q fleet. The majority of SR-71 sorties originating from Beale were training flights involving the simulator, SR-71A or B, or pilot proficiency flights in the T-38. (Lockheed Martin)

Roar accompanied us to the transient quarters to sleep in the same room with Jay and me. Early the next morning, he went with us to a military dining hall for breakfast. It was there that I got my first real surprise of the trip: the only food presented was about four types of fish soup, all of which, to this unaccustomed American, smelled terrible, especially so early in the morning. I asked if any cold cereal was available, and thankfully, there was. Cornflakes. Espresso coffee completed the fare.

General Aamoth joined us and with him was the American air attaché to Norway, who had just flown in from Oslo specifically to see us. I knew then that this visit was attracting more attention than any of us needed or wanted. He asked about the emergency, the condition of the airplane, and wanted to know if anything unusual or unpleasant had happened to us. I assured him that we were fine and that recoveries such as this one were well planned and the maintenance team would probably be here that day or the next. We did not anticipate any logistical problem as this type of activity was performed often, usually without help from other local organizations, and the Norwegians were taking extra care to assure that we were not contacted or hindered.

The rest of the day was devoted to making preparations for the maintenance recovery team from Beale AFB. General Aamoth, to my surprise, stated specifically that he did not want any talk or outward expression of anything clandestine (not that we would anyway). More than once, he made the explicit statement that when we landed, he considered us to be a NATO-allied aircraft in distress and that military courtesy and professional consideration meant that we were to be afforded the support necessary to see us on our way and that he did not want any mention of reconnaissance activity or publicity.

It was way too late for the admonition concerning publicity, however.

Virtually every newspaper in Norway had news of a 'spy plane' landing at Bodø splashed across its front page. Newspapers in the USA also had the story. The reports generally said that it was the highest-flying and fastest airplane in the world, and opined on what type of 'spying' we were doing. Jay and I did not like the publicity, but were relieved that no newspapers published our pictures or names. None of us flying reconnaissance missions wanted to be publicly identified while we were engaged in these activities. Our missions were highly classified, and no good could ever come from talking to reporters about anything associated with our reconnaissance flights.

The next day, 15 August, a KC-135Q from Beale AFB arrived carrying our special fuel for the SR-71, the deployment commander Lt Col Randy Hertzog, who was also the commander of the 1st Strategic Reconnaissance Squadron (1SRS), and the maintenance crew headed up by Jim Cook, plus civilian technical representatives from Lockheed.

The recovery plan written by the 9th SRW stated that in foreign stations, the recovery team would all wear civilian clothes so as not to disclose who was military. This did not sit well with General Aamoth! He told me to tell Col Hertzog to have all military personnel wear military uniforms. I did not know why he would issue such an order, but I complied. The military team dutifully returned to the KC-135 and changed into uniforms.

Skip Hosler provides an insight of the recovery of '964 from the maintenance crew's perspective:

Beale AFB. Morning roll-call for SR-71 flightline maintenance guys is at 06:45am. We're told '964 landed away at Bodø Norway. We need to get a recovery crew together.

I, like a dumb ass, volunteer and we take my crew, Airman First Class (A1C) Mathis, A1C Cane, and a few others. We also had Staff Sergeant (SSgt) Gene Cowell come with us and Master Sergeant (MSgt) Greg Blas would be team lead.

We packed the KC-135Q tanker with the required maintenance recovery items until noon. Then went home to pack our clothes, and met back at Beale's SAC terminal at 5:00pm.

We took off for Pease AFB NH and stopped there for gas for the tanker and a burger. We then headed over the North Pole and landed at Bodø Norway around 07:00am.

Aspen 31
Blown 72/73

The KC-135Q navigator was key to ensuring that the tanker initiated its turn perfectly, thereby ensuring that the SR-71 'receiver' arrived in close-trail. Note the grease pencil call signs Blown 72 and 73 are tankers and Aspen 31 the SR-71 (Aspen 30 was always the daily SR-71B call sign, whilst Aspen 31, 32 etc were used by SR-71As). (Paul F. Crickmore)

The SR-71 was parked out on an open ramp next to whatever sea is up there all covered in tarps. The first thing we need to accomplish, like on any other recovery, is to try and verify the maintenance problem that brought her there. We're told the air crew complained of a number 2 engine oil pressure issue. We'd brought Technical Sergeant (TSgt) Sullivan from the Beale J58 engine shop along (really good guy).

After hooking up a direct pressure reading gauge to verify whether it's an engine problem or just an oil press indication problem, Sully had trouble starting the engine. He opened the inlet aft bypass doors (which would allow more air to the engine on the ground). We also thought maybe the engine oil was too cold (the engine oil tank must be pre-heated to 70° in the winter), but Sully got it started. It rained, snowed, was foggy and humid the entire time we were there. You name it we had it.

The direct pressure reading gauge showed that it was an indication only problem, so the aircraft could fly to Mildenhall for final repair. We had about 25,000lb of fuel remaining onboard, enough to take off, catch the KC-135Q tanker and get back to England.

We worked until 11:00pm the first night, came back at 04:00am to put heaters on both engines. Preflight the aircraft and launch the bird out of there.

We brought air start turbines instead of Buick start carts. An 80lb air turbine is a lot easier to load on a tanker then a gazillion pound twin V8 start cart. We started the first engine with no issues. We went to start the second engine – no joy, it hangs up and won't go to idle. We swapped the air start turbines but still no joy. We tried changing the oil in the turbine, no joy. Just no joy in general. Now the pilot has to shut-down the already running engine, as he hasn't enough fuel remaining to get off the ground and catch the tanker.

From 80,000 feet, line-of-sight distance is about 320nm, depending upon prevailing weather conditions. The features distinguishable at such range would be a coastline, whilst a mountain range would probably be indicated by cumulous clouds built up over it. The earth's curvature isn't too well defined because water molecules in the troposphere often create a layer of haze. However, as the sun goes up or down through the terminator (the line dividing the illuminated and dark part of the planet), it is possible to see the curvature of the earth. (BC Thomas)

The KC-135Q tanker is circling overhead. He's overweight with JP7, but has to land so we can get the fuel off of him. We wait somewhat patiently, then we see this silver streak going by so fast we're not sure what it was – it was the tanker. Now he has to taxi back to us so we can get the required fuel.

The next thing we see are emergency vehicles heading his direction. Since he was heavy and couldn't stop in time, he ran off onto the asphalt overrun, tried to turn around and sunk right in. They had to throw chains around his main gear and pull him out.

The next day after getting the required amount of fuel off the tanker, one Buick start cart had arrived from Beale on a C-141. A second Buick is circling in a C-130 from Mildenhall as a backup.

Now let's get out of here. One engine has an air start turbine and the hard one to start has a Buick. Good to go! We start the first engine with the air start turbine, good to go. Go to start number 2, but it hangs up again and will not push up to idle. So we shut it down again, re-engage the Buick start probe, do an engine motor to get the engine temp (EGT) below 300°.

The pilot asks, do we go from motor to start or shutdown and restart. I said we have been here 3 days with no real food, we want to get to England! A1C Mathis is on the Buick start car controls. I tell him to hit it! Throttle down!

Usually, the specialists want to help pull the start cart away due to its weight, but I look and they're all backing away. MSgt Blas taps me on the shoulder and points to the starter probe at the engine connect point. It's kind of on fire and the air going through the nacelle is sucking it up. No one, other then those close, can see what's happening.

If we shut down, we're done again. Failure. Not very professional.

I show Mathis what's going on, we duck down below the top of the start cart and let it run, we hope! Finally, the pilot says idle, disconnect. When that start cart probe dropped out it was an orange brighter than the sun.

Dodged a bullet that day!

BC continues:

Since preparing the SR-71 for a supersonic (Mach 3) flight would have taken more equipment and time, we elected to fly subsonic directly to RAF Mildenhall, England, from which the SR-71 had conducted operations previously. We would fly in formation with the KC-135Q, which had landed at Bodø for our support two days earlier.

The maintenance crew performed outstandingly and we were ready to depart on Sunday 16 August. Pre-flight preparations for Jay and me were smooth, except that our first engine start attempt failed. The start cart could not, observing normal rpm and torque limits, achieve the required aircraft engine speed for a safe start. On the second attempt, the crew chief, Clarence 'Skip' Hosler, valiantly ignored the cart rpm/torque limits and informed me on interphone that this would be the last attempt. He later told me that the connecting rod glowed red-hot just before the aircraft engine reached the start rpm.

We took off at 1:42pm. It was the roughest take-off I ever made in an SR-71. The runway was smooth to sight, but owing to the very long, slender and flexible forebody of the SR-71 (where the nose wheel is located) and the distance from the nose wheels to the main landing gear (42ft), the slight undulating wavelike runway set up a vertical motion in the cockpit which amplified as we accelerated for take-off. It was getting so bad by the time we achieved rotation speed (180kt) that I was very concerned that something might break before lift-off (210kt). The acceleration of the SR-71 was quick and I was able to raise the nose before the up-and-down oscillation became traumatic. With the gear up, everything returned to normal. We rendezvoused with our tanker for a planned refuelling to augment our take-off fuel, and landed at 2:53pm local time in England, for a flight of 2.2 hours.

With a million members of the Polish Solidarity movement having gone on strike on 7 August, and mounting tension between communist state officials and the rest of the Polish population, SAC directed that upon arrival we would set up a deployment base at RAF Mildenhall and conduct several additional operational missions before returning home. Jerry Glasser and Mac Hornbaker were sent from Beale AFB to meet us when we arrived from Norway and they flew an operational mission a few days later. We were ordered to stay at RAF Mildenhall until relieved, so Jay and I also flew another operational mission after Jerry and Mac. When Rich Young and Ed Bethart arrived as our replacements, we departed for Beale AFB on 2 September ['964 finally left Mildenhall and returned to Beale on 6 November].

What started out for us as a 10.5-hour, round-robin mission, California to the Soviet Union and back, turned into a 21-day marathon of SR-71 missions, involving six SR-71 aircrew members, a host of maintenance and support personnel, and a true adventure for us all.

Along the way, we made some very special friends.

POST SCRIPT

After I retired from the US Air Force and our SR-71 reconnaissance activities were no longer classified, I contacted General Aamoth. He had also retired from the military after being chief of staff for the Norwegian Air Force from 1985 through 1991.

I asked him about his reluctance to have our military personnel wear civilian clothes and why he admonished us not to do or say anything that would identify our mission as being reconnaissance. He told me a very interesting story: on 1 May 1960, General Aamoth was a fighter pilot (Lieutenant), in the Norwegian Air Force stationed at Bodø. That was the day that Francis Gary Powers was shot down flying a CIA U-2 aircraft over the Soviet Union. Although Powers had taken off from Pakistan, his intended landing base was Bodø, the same Norwegian base at which I landed. Furthermore, the (then) commander of Bodø knew about the U-2 and that it was to land at his home base; however, neither the Norwegian prime minister nor the chief of the Norwegian Air Force knew anything about it. To make matters much worse, the Soviet premier, Nikita Khrushchev, threatened to 'nuke Bodø' for 'cooperating' with the United States in the 'U-2 Affair'. After an investigation, the military commander was summarily fired.

General Aamoth saw a very stark parallel to that story when we landed. He told me that he was sitting in his office when we were on final approach. The airfield tower controller telephoned and told him to look out his window to see what aircraft was landing at his field asking to be parked on his military airfield apron.

I now understand General Aamoth's concern!

THE FALKLANDS

Argentina invaded and captured the Falkland Islands on 2 April 1982. Three days later, a Royal Navy task force set sail from Portsmouth with the objective of driving the invaders out and returning the islands to British rule. Twenty days later, Royal Marine commandos recaptured South Georgia island and soon after, President Reagan pledged American support to Britain. He branded the Argentinians 'aggressors' and ordered economic sanctions against them. He also offered to supply Britain with 'unspecified' war materiel to assist in the recapture.

Seventy-three days after the invasion, British troops completed their objective and the Union Jack flew over the Falklands once again. Did the SR-71 fly over the islands during the conflict? An analysis of the problem took place at the Pentagon. The study showed that SR-71s could have covered the area easily if SAC could operate KC-135s from South American bases: this, however, was politically unacceptable. It was too difficult to operate the KC-135s exclusively from the US because they could not take on fuel in flight. KC-10s were not available to buddy refuel the tankers far enough, so the idea was dropped and the task was left to other sensors.

GIANT PLATE AND CLIPPER SORTIES

The origins of US high-altitude surveillance of Cuba can be traced back to 1962 and the now infamous missile crisis. SAC U-2s continued to regularly monitor the island, located just 90 miles from the southern tip of Florida, until the task was passed to the SR-71 in September 1974. The reason behind the move was the sheer number of commitments undertaken by the U-2 fleet throughout the world, which had recently increased still further to include monitoring the Middle East from the Mediterranean island of Cyprus after the Yom Kippur War.

Headquarters SAC had, as far back as 1 July 1970, prepared a contingency plan for such an event, codenamed Giant Plate. The primary objective of these sorties was to collect PHOTINT, and about 90 per cent of the Cuban landmass was photographed on every mission. However, unlike other SR-71 sorties, it was the interagency 40 Committee (and later the 303 Committee) that decided when such a sortie would be launched rather than the SRC. For planning purposes, these committees instructed the JCS to direct SAC to prepare for such a sortie once every 30 to 40 days. Through 1975 and 1976, however, the Giant Plate mission rate averaged out at only one every 55 days.

To conduct these round-robin sorties from Beale it was necessary for the SR-71 to undertake three air refuellings (six different tracks had been established in the Caribbean area for this task). A typical mission lasted about 5.5 hours, of which around 50 minutes was spent in the collection area. Of particular interest to the JCS was the deployment of any new weaponry from either the Soviet Union or Eastern Europe, and the monitoring of the Soviet naval task forces that regularly visited the island. Each Giant Plate sortie was carefully monitored and tracked on radar by the Cubans; as a consequence, the SRC varied the aircraft's track on every mission. The first sortie took place on 26 September 1974 and the aircraft was crewed by Maj Lee Ransom and his RSO Maj Al Payne.

In response to a significant adjustment in United States foreign policy made towards Cuba in early 1977 by President Jimmy Carter, the JCS directed Headquarters SAC to end all Giant Plate overflights. As a consequence, on 11 January 1977 the last planned sortie in a series of 18 missions was completed by Capt Maury Rosenberg and the same RSO that had conducted the first, Maj Al

Payne. Unfortunately for the crew and photo interpreters, the western half of the island was blanketed by heavy cloud. In addition, the OBC's film guidance rollers became loose in their mounts, damaging what little imagery that had been clear of cloud.

Despite the Carter administration's benevolence towards the Caribbean island, it soon transpired that in spite of earlier conciliatory rhetoric, Castro had actually accelerated Cuba's export of Marxist revolution to several developing nations in Central America, Latin America and Africa. By the summer of 1978, US State Department estimates believed that there were no fewer than 40,000 Cuban soldiers and civilians in 14 African countries. Later that same year a reconnaissance satellite photographed a Soviet freighter in Havana harbour, surrounded by large crates that were being moved to a nearby air base where aircraft were being reassembled.

It appeared that 15 MiG-23s had been supplied to Castro's air force. Such an upgrading of Cuban air strength was worrying. The MiG-23BN 'Flogger-H' was known to be capable of carrying nuclear weapons and if it was indeed this variant that had been exported, then the shipment violated the 1962 Kennedy–Khrushchev accord, in which the Soviets had pledged not to deploy offensive weaponry on Cuba.

A decision was therefore made in November 1978 to fly SR-71s over Cuba to identify the MiG variant – the first mission was flown on 12 November. A lack of surveillance of the island over the intervening 22 months generated an enormous list of targets from national intelligence users, much of which was aimed at proving compliance with the earlier accord by establishing the absence of weapon systems that would constitute a violation by the Castro regime.

On 20 November, President Carter said that the Soviet Union had assured him both publicly and privately that the MiG-23 jets were in Cuba for defensive purposes only. A *Pravda* commentary citing the American press said 'the presence of such aircraft would run counter to the 1962 agreement'. It went on to say that the MiG reports 'were groundless and a provocation from beginning to end'. Photographs taken by the SR-71 confirmed the Soviet claims – the aircraft were indeed MiG-23MS 'Flogger-Es', optimized for the air defence role.

On 1 December 1978, amid concerns that the classified mission codename Giant Plate had been compromised, SAC HQ assigned a new one, Giant Clipper, to Fragmentary (Frag) Order 60-FY-14-01, which governed the execution of all SR-71 Cuban reconnaissance missions.

Nonetheless, bellicose statements and the reported presence of a Russian brigade did nothing to reduce US concerns over Cuban intentions in the area and threatened the Senate's ratification of the Strategic Arms Limitation Treaty. As a result, the 12 November mission actually set a precedent for flying further SR-71 monitoring sorties over the island and resulted in the JCS directing SAC to conduct ten additional sorties in 1979; these took place on 22 and 31 May, 15 and 28 June, 27 July, 20 and 29 September and 5, 16 and 20 October.

The need to build up a RADINT database of the island dictated that the first four sorties flown in 1979 would use the SR-71's HRR capability. The DIA requested that the aircraft's ELINT systems should also be used to collect signals data. The 27 July mission, however, was a photo overflight and this was used to help evaluate and validate HRR imagery collected during the four earlier RADINT missions.

During 1980, just five Giant Clipper sorties were flown, these taking place on 15 January, 2 February, 17 March, and 3 and 22 July. The dates on which the SR-71 executed the majority of its Giant Plate/Giant Clipper sorties can be attributed directly to two periods of increased tension between the United States and Cuba. The first was the MiG issue, the second the build-up of Soviet troops on the island.

The latter led to frenetic behind-the-scenes negotiations with Leonid Brezhnev's Soviet Union, which continued to insist that the role of its people on the island was no different to what it had been prior to 1979. But such statements failed to pacify the Carter administration and it announced the implementation of five policies in response to the brigade's presence. The first of these was to increase the level of US surveillance of Cuba and the eight Giant Clipper sorties flown between 5 October 1979 and 22 July 1980 were a central plank of this policy. Other measures included reassuring Latin American nations that the US would protect them against any Communist incursions; it also promised an increase in the number of US military exercises in the Caribbean and provided greater levels of economic assistance to the region, as well as establishing a US Caribbean Joint Task Force with its headquarters at Key West, Florida.

From early April 1980, thousands of Cubans unhappy with the nation's communist regime sought political asylum in the Peruvian embassy in Havana. Later that month, after much wrangling, Castro allowed any disgruntled Cuban national to seek asylum in the United States. This resulted in a deluge of people leaving the island on more than 600 small boats owned by Cuban-Americans living in Florida and intent upon transporting their friends and relations off the Caribbean island to 'The Land of Plenty'. By mid-summer 1980, it was estimated that 125,000 refugees had arrived in Key West.

The Giant Clipper sortie flown on 3 July 1980 provided the photo interpreters with outstanding imagery in which it was possible to establish that the mass exodus off the island had ended. They counted two large merchant vessels, one small merchant ship, 28 fishing boats, and one probable factory ship in the harbour, but no people. A merchant ship approximately 185ft long and of the type that had been used to transport refugees was tied up at Mariel, its decks clear of people and cargo. The SR-71's imagery also showed two unoccupied tents erected on the pier near the merchant ship; they had been cordoned off with ropes. The photo interpreters found no groups of probable refugees in the quay area, the Rio Mosquitos refugee processing site was being dismantled and 31 of the known 45 tents used as temporary accommodation were also gone. To ensure that both SAC HQ and the DIA had the most timely information available, imagery interpreters at the 9th RTS provided them with telephonic and teletype reports, so that these could be immediately relayed to the White House Situation Room.

A CHANGE AT THE TOP

On 20 January 1981, the United States' 40th president was sworn into office and Ronald Reagan adopted a far more robust attitude towards the Soviet Union, Cuba and other wayward states, and this was reflected in the more bullish way that SR-71 operations were conducted.

Maj Dave Peters recalls:

> We flew regular missions against Cuba during my time in the program, but the vast majority were flown using our High Resolution Radar. It had the capability to photograph anything on the island and enable us to remain in international waters. But this particular mission was flown as a daytime overflight, using our optical cameras. The mission had a very specific time over target (TOT) of 10:00am local, and a very specific target, the José Martí International Airport.
>
> We took off at about 4:30am Beale time, in order to hit our TOT on time. We refuelled northeast of Beale and then flew supersonic to New Orleans, where we refuelled again. We then climbed out, accelerating to 3.2 Mach and headed for the western tip of the island. My RSO Ed Bethard was closely monitoring our progress and we adjusted our speed to ensure we arrived on time. We flew

> right down the middle of the island, straight across José Martí and on to the east of the island, where we made a big 90/270 turn and streaked back up the island from east to west, again going over the airport. After coasting out, we went back to the refuelling track and fuelled up for the return to Beale.
>
> We were told that the importance of the timing was the sun angle, so that the photo interpreters could determine the size of the buildings and other objects by their shadows. Now that part is true, in that many of our optical missions were planned for that aspect. Then, as Paul Harvey used to say, 'here is the rest of the story':
>
> We heard that in the photos of José Martí were pictures of Fidel Castro and the Soviet statesman. Imagine Castro's thoughts when he heard the unmistakable double sonic boom of the SR-71, not once but twice, as he welcomed his guest!

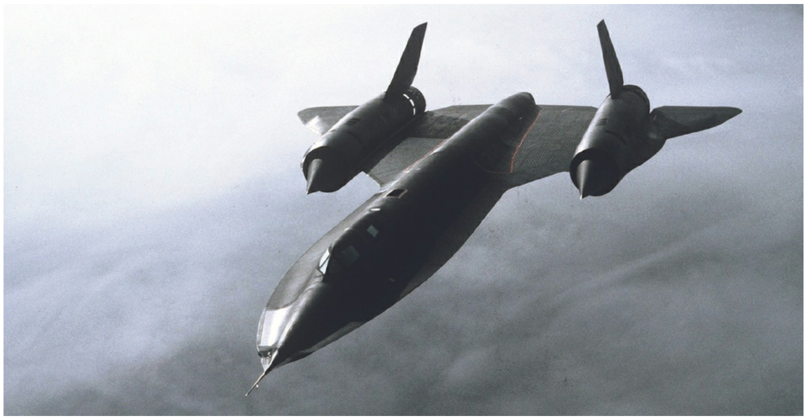
Majors Joe Matthews and Curt Osterheld completed Giant Clipper route YC-437 in '980 on 30 April 1984. During the 5.8hr sortie they flew a distance of 6,750 miles, reached an altitude of 76,500ft and a maximum speed of Mach 3.12.

A year later, Majors Lionel 'Stormy' Boudreaux and Ted Ross were scheduled to fly a monitoring mission against Cuba. They departed Beale at 04:00am on 19 June 1985 in '980. After their first air refuelling north of Salt Lake City, they turned southeast toward the target area. Castro had always held a belligerent attitude toward the US and almost inevitably his missile crews frequently spoofed SA-2 firings against the over-flyers. Many crews believed it was only a question of time before a SAM was fired their way, so advanced DEF systems were carried to counter such action. Part of the pre-penetration procedure saw the DEFs fully checked out and the aircraft flying up to maximum speed before backing off to cruise speed to ensure that the inlets were performing at their best for SAM dodging.

After '980 reached Mach 3.2 to test full-speed operations, Stormy began backing off to Mach 3.0 cruise while Ted checked out the new DEF system. At that instant, the nose pitched up more than 10° before Stormy could reach the stick to stop the rise. Since he was flying with his right hand on the autopilot pitch wheel (where the right index finger moved a very small control wheel to adjust fine increments of nose-up or nose-down deflection), his hand was out of position for immediate reaction. He quickly moved his hand to the stick and exerted enough force to stop the dangerous pitching action.

Since Stormy was beginning to slow down, the aircraft was in a nose-up trim condition when all three DAFICS computers decided to shut down. The SR-71 was well out of trim and the SAS was not there to help when it was most needed. Without the SAS to dampen Stormy's sharp nose-down input, '980 responded with an equally sharp nose-down sweep of more than 15°. Stormy jerked the stick back, which caused a sudden up-sweep, as he recalled:

> I had little time to analyse what was going on because things were happening so rapidly. Unfortunately, each oscillation was getting larger. It seemed that I was trying to learn the flight characteristics of a completely new airplane in a few seconds. Certainly, I'd never experienced anything like this before. In training we were only allowed to fly the aircraft with either pitch or roll or yaw SAS off, and that was at a benign 25,000ft at 0.90 Mach. The loss of one channel of SAS was an abort item.
>
> I tried hard not to over-control the aircraft and to get the nose back on the horizon. As the nose reared up again to an ungodly 20°, I knew that this would probably be the last chance I'd get before the aircraft exceeded the restoring capability of the controls. The aircraft would surely depart the flight envelope and disintegrate. Fortunately, I was still flying straight ahead, though we were still well above Mach 3. We hadn't deviated from our flight path and these oscillations were exposing the aircraft's underside forebody to awesome airstream loads. As the nose came up again, I hit the forward stop on the stick and still the nose kept rising. When it stopped, I cranked in just a little forward trim and, by the grace of God, the nose started coming back down! I eased off some stick pressure, just enough to stop it deviating by much more than 5°, from which I could progressively make smaller pitch movements.
>
> When I got that bucking bronco back to some proximity of level flight with the pitot tube near the horizon, I tried to maintain that position while I groped around the base of the stick for three red-cover 'guarded' re-set switches for the DAFICS computers. They were low and to the right and I was holding the stick with my right hand and trying with my left to reach around behind the back of the stick to reach these switches. Unfortunately, the metal cuff ring that secured my gloves to the rest of my pressure suit kept hitting the stick, causing the aircraft to pitch and roll. I soon realised that I'd have to change hands. I managed to do that without over-controlling and was finally able to engage the SAS channel. After that success, the rest was easy.



Aspen 31 side-slips to the right having topped up its tanks during a training sortie from Beale on 3 December 1986. (Paul F. Crickmore)

With SR-71 flight time at a premium (a pilot would only fly three or four times a month), Beale's Northrop T-38 Talons provided a cost-effective way for Habu pilots to keep their skill-set sharp and they'd fly the type eight or more times a month. (Paul F. Crickmore)

> When we analysed the MRS printout back at Beale, I learned that the inlet restart switch had activated automatically following the DAFICS shutdown. This action caused the spikes to travel forward and had opened the forward bypass doors that prevented unstarts, which would have added to our woes.
>
> Through all of this excitement, Ted remained remarkably calm despite the 6lb checklist ripping free from the two 6×6in. Velcro pads that had held it on his lap. It's during such frightening emergencies that I'm in awe of RSOs, who have to read checklists and sit it out. At least the pilots have plenty to keep themselves busy with, and less time to consider their fate.

Stormy aborted the mission and recovered to Beale, where it was discovered that the triple DAFICS computer shutdown was caused by a voltage drop triggered when Ted activated the new DEF system (something the engineers had said could never happen). The fault circuitry in the computer had detected this power loss and it shut down.

On 29 May 1986, Maj Rod Dyckman and Maj Tom Bergam had completed their recon-run of Cuba in '962, when they experienced an inflight incident, as Rod explains:

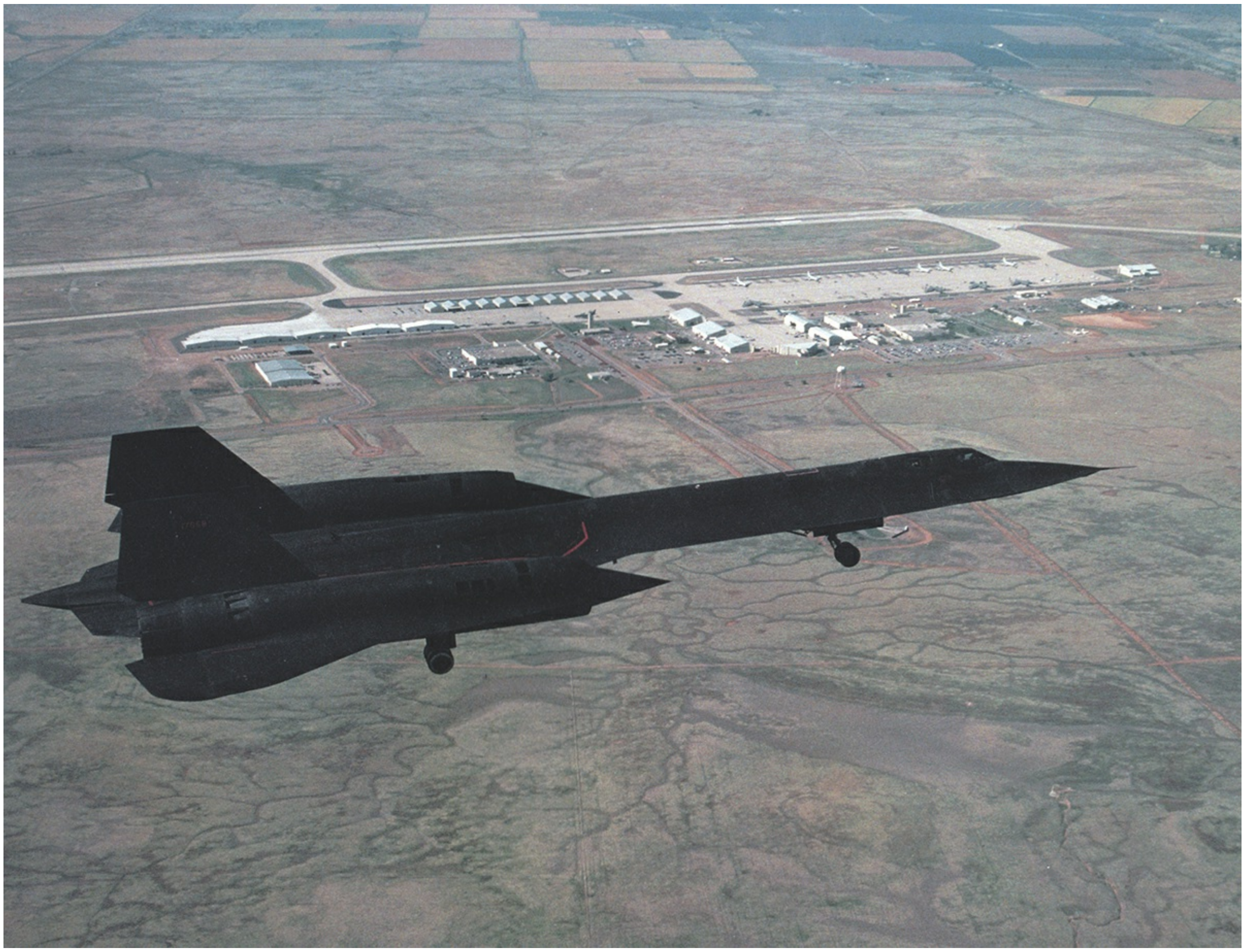
> I experienced an engine failure just prior to descent for our third and last refuelling. It should be stated that our typical refuelling points were placed so that a diversion to an alternate was possible if refuelling was aborted for any reason. Also inherent in our operation, the refuelling tracks were spaced so that we would be at or near minimum fuel (less refuelling required). On this particular mission, we were in the Gulf of Mexico and near the normal descent point when we had an engine failure. The descent rate is significantly higher with an engine failure and without refuelling we would have run out of gas before we reached land. As far as I know, no other pilot was required to single-engine refuel in the history of the program. Single engine refuelling was more difficult, because of asymmetric

> thrust and no roll stability augmentation. We did not recover the engine and after refuelling, we made an emergency landing at Tyndall AFB, Florida.

NICARAGUA

Some months earlier, SR-71s had overflown Nicaragua for the first time. After the downfall of the dictator Anastasio Somoza Debayle, a Marxist government was established, which immediately requested Soviet military aid. In the autumn of 1984, a team of US 'crateologists' became interested in a cargo on board a Soviet freighter that had docked in Nicaragua. Photographs taken by a US reconnaissance satellite showed what was believed to be MiG-21 interceptors. Nicaragua denied that the crates contained MiGs and maintained that the cargo consisted of Mi-8 'Hip' helicopters.

After presidential clearance, six reconnaissance sorties were flown over Nicaragua from Beale. The first was flown on 7 November 1984, by Maj Bob Behler and Capt Ron Tabor (this crew flew three of the six sorties over Central America). As a result of their work and correlative intelligence, the MiG-21/Mi-8 wrangle slowly faded from the headlines, along with rumours of a possible US invasion of Nicaragua. Some months later, the world's press confirmed that no MiG-21s had been shipped to Nicaragua: on this occasion the photo interpreters were off the mark.



Flying a visual training circuit at Beale, '968 lowers the gear on the down-wind leg. Note the 12 SR-71 'barns', two of which are open, and the four U-2s parked opposite. There are 11 KC-135Qs on the tanker ramp, five in grey and six camouflaged. (Lockheed Martin).

CONTINUING CREW TRAINING

The flight crew training programme underwent continued development over the years. When Major Tom Danielson joined the programme and began his SR-71 pilot training on 12 August 1985, he had no idea just how soon he'd reap the rewards of its thoroughness and intensity:

> My RSO was to be Stan Gudmundson, and as I recall, Stan and I completed a bit over 250 hours in the simulator, plus academic instruction and numerous hours of personal study, either in the simulator building or the squadron, since all study materials were classified and couldn't be taken home – I can tell you, we certainly had the combination to our crew safe memorized! My first sortie in

the SR-71B was about 6 months after beginning the course – pretty much the norm.

Pilots were given five SR-71B sorties with Instructor Pilots (IPs), the fifth was actually a Qualification check in the airplane. That 'Qual check' had to be successfully completed prior to being scheduled for your first SR-71A flight. The first A model sortie was with an Instructor Reconnaissance Systems Officer (IRSO); student RSOs had one flight with an IP in an SR-71A, prior to flying with their allocated pilot. As a personal aside – Stan was the finest RSO I could imagine.

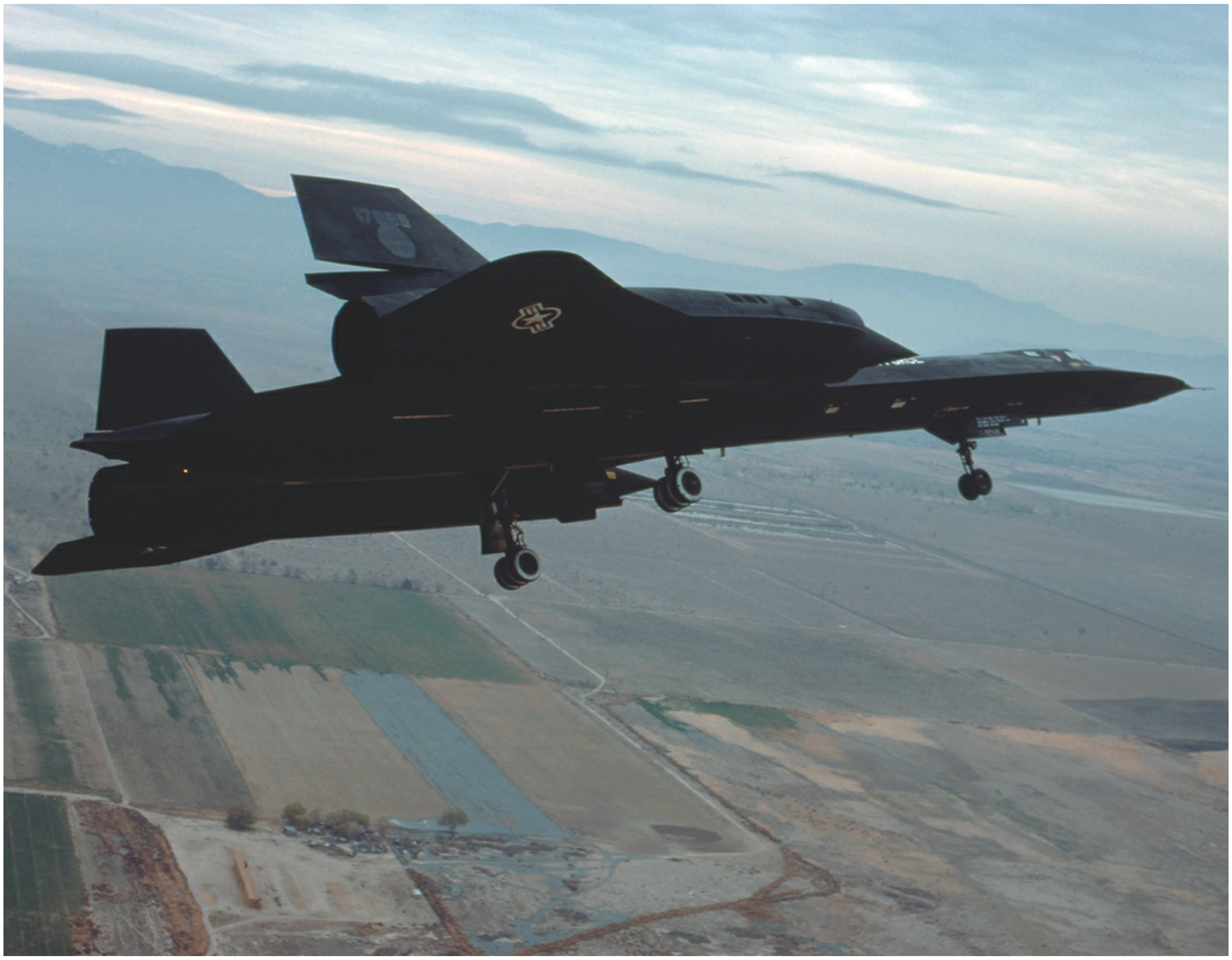
On my 6th mission (my first flight in the 'A' model), I was flying a 'Double Loop' mission in 61-7971. This meant that we conducted two in-flight refuellings and, of course, two supersonic accelerations and subsequent cruise legs. About 15 minutes before our final start of descent procedure to land at Beale, we were flying at Mach 3 at about 80,000ft. Flying straight and level, we had an unstart.

Ours was somewhat benign (above Mach 2.3, a crosstie system activates both inlets through the recovery process after which the inlets will recover in 4½ seconds). With the inlets recovered, I noticed that the left inlet had recovered to a significantly different set of inlet instrument readings than before the unstart. The aircraft also had noticeable airframe vibrations. I opened the rear-viewing periscope and saw a large contrail only on the left side, with obvious fuel streaming from the left engine. Quickly conferring with Major Ron Tabor, my IRSO, we determined that neither of us had experienced anything like this situation and that we had a significant airplane problem. Shortly afterwards, the Oil Pressure Warning Light illuminated, and I closely monitored the actual Oil Pressure gauge. Initially, the pressure remained normal, but it soon began decreasing. As it dropped below the minimum of 35psi, I shut the engine down with the throttle. We began a single-engine descent while accomplishing all engine shutdown and single engine descent checklists. Even during a fairly low power descent, significant rudder input and rudder trim was needed. Radio calls were made informing both Beale Command Post and Oakland Control Center, as we were an 'emergency aircraft'. Of course, they were not controlling us, but we wanted to make sure all aircraft on their system remained well clear.

As we began our final approach, I needed fairly high power from our 'good' left engine. I used manual rudder, since I didn't want lots of rudder trim for landing and subsequent landing rollout. The landing was uneventful.

U.S. AIR FORCE
17956
1000th SORTIE
956

SR-71B '956 is seen on its 1,000th sortie. Following the loss of '957 on 11 January 1968, '956 was the sole surviving two-seat pilot trainer until the so-called SR-71C was created. (Lockheed Martin via Tony Landis)

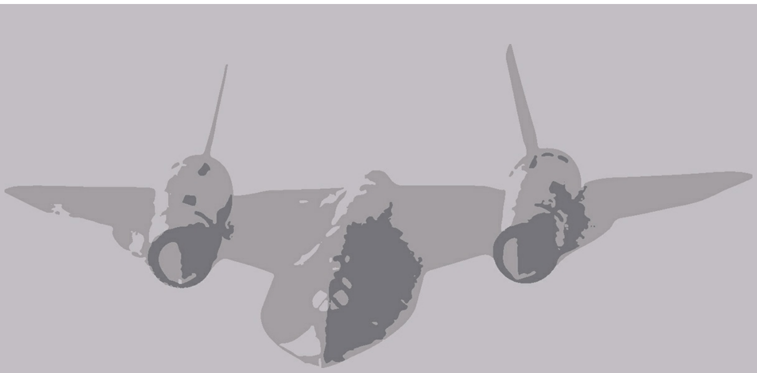


When Lockheed Martin approached the US Air Force for clearance to use an SR-71 in a film made near the end of its career, the 'fighter mafia' at SAC denied permission. AFLC, however, came to the rescue and made '955 available – note the painted-out serial and Skunk logo. (Lockheed Martin via Tony Landis)

POST SCRIPT

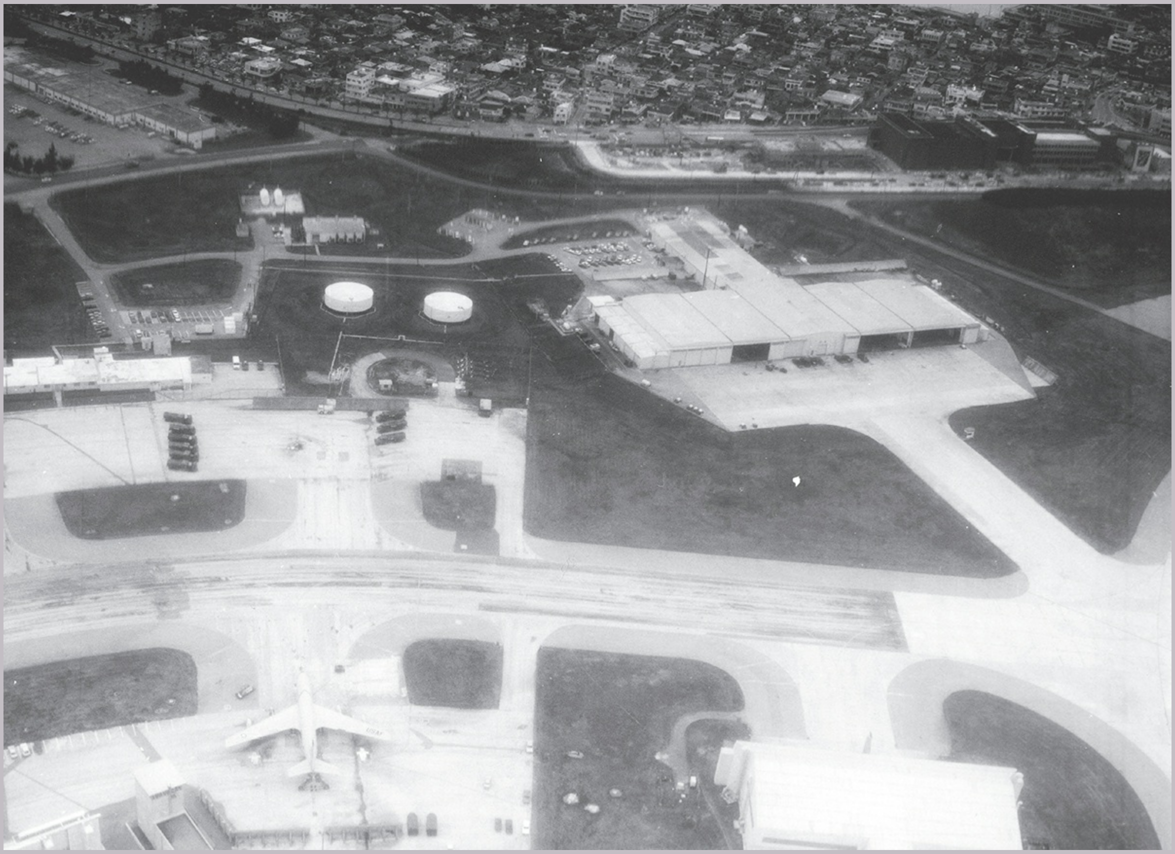
> Subsequent disassembly of the right engine revealed a second stage compressor blade tip had broken off and punctured the oil tank, causing a loss of engine oil. The severe engine vibrations had broken a high-pressure fuel line, resulting in the streaming fuel vapor and fuel 'contrail'. I subsequently commented that the very first 'A' model sortie malfunction and subsequent recovery was easier than any of our simulator missions. I only had to deal with one rather large problem that day, whereas on simulator missions, we had to deal with many, many problems. The only thing that really got my attention was that this was a real jet.

On 22 November 1989, all SR-71 flights were suspended except for minimum proficiency flights and the Senior Crown programme entered a period of uncertainty.



CHAPTER 13:

OL–8 OPERATIONS DURING THE VIETNAM WAR



The 9th SRW's detachment at Kadena inherited first-rate facilities from the CIA's project Black Shield. The four hangars had the maintenance complex located in the middle. In the early 1970s, at the height of the Vietnam War, SR-71s occupied all four hangars. Also easily visible are the two JP-7 fuel storage tanks. (Lockheed Martin via Tony Landis)

Strategic Air Command was both a major command of the US Air Force and a Joint Chiefs of Staff specified command. Headquarters USAF assigned SAC the responsibility for all strategic reconnaissance and the command executed its mission under the supervision and guidance of the Chief of Staff, US Air Force.

In part, the Commander-in-Chief SAC (CINCSAC – pronounced 'sink sack') was directed 'to prepare plans for strategic aerospace reconnaissance for which the Air Force [is] responsible (electronic, weather, visual, aerial, photographic, cartographic, reproduction, and related activities) to meet the global requirements of the Department of Defense.'

As a specified command, SAC received assignments directly from the JCS, which included photographic and signal coverage of selected areas together with global upper atmospheric sampling. Requirements for individual reconnaissance programmes were specified and outlined in operations and fragmentary orders. Through its Strategic Reconnaissance Center at Offutt AFB, Nebraska, Headquarters SAC exercised operational control over all such missions, supervising their planning, scheduling and execution, unless such functions had been specially delegated in a SAC operational order. In addition, a higher oversight level was added following the shooting down by Soviet MiG-17s of an RB-47H whilst gathering ELINT in international airspace near the Kola Peninsula. The Joint Reconnaissance Center (JRC) was established by President Eisenhower on 1 July 1960 at the Pentagon to oversee all US reconnaissance operations.

In the specific case of SR-71 operations, codenamed Giant Elk by SAC, these were planned by specialists in the SR-71 branch at the SRC in response to tasking by the JCS, initially in support of the SAC Single Integrated Operational Plan, the Defence Intelligence Agency the Commander-in-Chief Pacific (CINCPAC), Seventh Air Force, Military Assistance Command Vietnam and Commander United States Air Forces in Korea (COMUSKOREA). Senior officers at the SRC participated in twice-daily meetings, one held at 7:30am, the other at 3:30pm, to review current mission tasking, planning and the weather. Once the SRC had completed the mission planning process, details were forwarded to the JCS for final approval.

BUILDING 500

Frank Stampf, a former F-4 weapon system officer and Habu RSO, provides first-hand insight into the workings of the SRC:

Headquarters SAC, Building 500, Offutt AFB, Nebraska, was the place where the means to carry out America's Cold War doctrines of 'strategic deterrence' were planned and directed under considerable secrecy, and even more considerable security. SAC was the keeper of two legs of the nation's nuclear 'triad' – the strategic bomber fleet and the intercontinental ballistic missile force. (The third leg was the US Navy's nuclear ballistic missile submarine fleet.) As such, SAC had responsibility for developing and maintaining the plans – and capability – to conduct nuclear strikes on thousands of Soviet and Warsaw Pact military and industrial targets, should the president ever determine it was time to give the order. Consequently, the SAC Headquarters building had more than its share of high-level security measures to protect that capability. Building 500 itself was a cross between rather nondescript boxy brick and glass architecture and an imposing presence, depending upon how much one knew (or cared) about what went on inside the structure.

To provide a bit of context, it must be understood that any description I give of that building is from the perspective of a crewmember who did not grow up in the SAC environment. At the risk of stereotyping, I don't think aircrews of that generation would argue with the notion that Tactical Air Command fighter crews enjoyed having themselves characterized as the 'devil-may-care-scarf-flying-in-the-slipstream' type of aviators who rarely broke the rules, but generally did everything possible to bend, circumvent, or otherwise 'beg forgiveness rather than ask permission'. On the other hand, at least in the eyes of the fighter crews, SAC was the realm of the 'hard core-do-it-by-the-book, by God' aircrews who never, ever would even *dream* of operating outside the tightly defined constraints of SAC's nuclear strike mission guidelines.

In retrospect, this was certainly not a *bad* thing – remember Slim Pickens as the hat-waving cowboy B-52 pilot who rode his atomic bomb like a rodeo bull right down to his assigned 'commie ground zero' target in the movie *Dr Strangelove*? That was definitely a product of Hollywood. The point is that once one was inside the Headquarters SAC building, the atmosphere was pure business, and it was apparent that the business being conducted within those walls was deadly serious.

Having said all that, SAC Headquarters, even viewed from the eyes of a TAC-bred aviator, was a pretty amazing place. By the early 1980s, Building 500 was one of the first military facilities, at least that I saw, that had concrete barriers placed strategically around the building so that a would-be attacker could not (at least not easily) drive a car laden with high explosives into the front lobby or other entrances. Even those personnel assigned to the headquarters had to park quite a distance from the building and walk, winding their way through the maze of barriers (usually, it seemed, in a snowstorm) before reaching the front entrance. Once inside the lobby, you could go no further than the security desk, where you had to show the young airman of the SAC Elite Guard your SAC ID badge. The badge, if properly annotated, authorized the bearer into the building, but did not necessarily give access to *all* of the building once inside. Each individual's badge was designed to allow access only into those specific areas for which the individual was cleared and had a 'need-to-know' regarding the work being carried out behind the doors.

After being properly identified by the guard and allowed to pass the main desk, you would then slide your badge into the slot of a turnstile barrier, similar to those used in the subway systems of large cities. Once again, your badge would be automatically 'read' by the security system to ensure that you indeed were authorized access into the building, and the turnstile would unlock, letting you past the front lobby.

For us 'recce' types who worked in the Strategic Reconnaissance Center that was the last light of day we would see for a while, since the SRC was located in the lower depths of Building 500. A few feet after passing through the turnstile we would begin the descent down the several flights of stairs taking us to the basement 'vaults'. Once downstairs, a short walk would put us in front of the secure entry door to the SRC. Again, the ID badge was run through a slot and if all was correct, the door would open to let you into the world of strategic reconnaissance.

As you entered the SRC your first sight was the operations desk, which was manned 24 hours a day, 365 days a year. Behind the desk were two duty officers, both former strategic reconnaissance crewmembers, and an enlisted operations specialist, who assisted the duty officers in keeping track of all the recent, ongoing, and upcoming reconnaissance missions flown by RC-135, U-2/TR-1 and SR-71 aircraft all over the globe. Needless to say, the level of activity behind the desk was pretty constant, with secure phones and other communications media in a regular state of cacophony, reporting the status of real-world reconnaissance sorties flying from operational detachments around the world and around the clock. Well before the days of high-tech computer capabilities, all those sorties were tracked and displayed on nothing more than a large black, back-lit grease board using varying colours of grease pencil to annotate sorties scheduled, airborne, complete, delayed, or cancelled; and guess what – even without the technology it worked just fine…

Turning left from the ops desk took you into the offices and planning areas for the RC-135 fleet. Turning right would take you through the SRC briefing room, decorated with photos of strategic recon aircraft dating back to the early days of the Cold War. Passing through, the briefing room led to 'high-flyers' country. This was the area occupied by the U-2/TR-1 and SR-71 folks. After passing the office of the colonel in charge, the short hallway opened up to the large mission planning area shared by the U-2/TR-1 and SR-71 planning and operations staffs.

The space was divided longitudinally by an oversized planning table, peaked along the top with sides sloping to either side, one facing the U-2/TR-1 troops and the other the SR guys. The large, slanted surfaces, very much like drafting tables, gave us a place to lay out the navigation charts we used to review and/or plan the sorties being flown at our operational locations worldwide. Although the majority of the more 'routine' missions were planned at the operational detachments, SRC staff still assisted the detachment planners in preparing for high-priority sorties that were out of the ordinary. Each of the SRC staff members also had a desk in the room, which allowed us to pass information easily among ourselves (or just shoot the breeze in the rare 'slow' moments).

The entire area, from the point you opened the door to enter the SRC near the ops desk, was specially designed and built as a Special Compartmented Intelligence Facility, or SCIF. Therefore, it was permissible to have highly classified information and materials out in the open, and to discuss classified mission details with other staff members. This greatly simplified the planning and coordination process. Underneath the planning table were rows upon rows of sectional navigation charts covering every area of the world. These were the days before sophisticated flight planning computers and Global Positioning System technology were in use. Consequently, the slim tolerances for navigational error when planning an SR-71 mission to be flown at 2,000mph within tenths of a mile of politically sensitive borders required extremely accurate planning and execution. Every detail of mission plans, especially for the more demanding and high-visibility sorties, was checked and re-checked by the planners, both at the operational detachments and at SRC.

No description of the SRC could be complete without mention of 'The Phone'. In a small booth at the far end of the large planning room was a black telephone with a very distinctive (and particularly annoying) ring. It was the 'secure' line with which we communicated secret stuff with anyone we needed to outside of the SRC SCIF. This included our counterparts at the Joint Recon Center in the

Pentagon, the SR-71 wing in California, and the operational detachments in Okinawa and England. It also included the folks at the National Security Agency, the Defense Intelligence Agency, and, once in a while, the Central Intelligence Agency.

All of us at the SRC worked lots of long hours, many nights and regular weekends. As a result, we all enjoyed those rare moments when everything appeared to be under control, we were ahead of the power curve for any known tasking coming down the pipe, and the generals in the building were (for once) preoccupied with something, or someone, other than us. Every so often, that unique confluence of conditions would occur on a Friday afternoon. As the hours of the day slipped by, we all began to hope against hope that the clock would finally read 5:30pm, we would be able to close up the shop, and at least temporarily leave the reconnaissance world in the hands of the guys at the ops desk. We would plan to slip off to the Officers' Club for a well-deserved beer and the opportunity to swap war stories of our longed-for flying days.

Almost inevitably, just as we were almost tip-toeing toward the door and about to turn off the lights, 'The Phone' would blast its annoying clanging ring as if to say 'not so fast, you recce pukes…' And another long night would just be beginning.

THE STAGE IS SET

When President Johnson endorsed the CIA Director's 31 December 1966 decision to terminate the Oxcart programme, a schedule for the phase-out of the A-12 fleet was formulated to meet a 1 January 1968 deadline. On 10 January 1967, the head of the project advised Deputy Secretary of Defense Cyrus Vance that four A-12s would be placed in storage in July, two more in December, and the last four in January 1968.

In May 1967, Vance directed that the SR-71 assume contingency responsibility to conduct Cuban overflights in July, and that the Senior Crown programme was also to be ready to cover Vietnam by 1 December 1967. His directive provided for a short overlap between the outgoing 'covert' A-12 programme and the incoming 'overt' SR-71. In the event, the date of the changeover slipped five months, giving Oxcart a brief stay of execution.

As the 1st SRS neared operational readiness, decisions were made by Colonel Bill Hayes (the 9th SRW commander) and Colonel Hal Confer (the Director of Operations) as to which crews would be first to be deployed to Kadena AB on the island of Okinawa. The eight crewmembers they selected began training for the deployment, flying simulator sorties depicting the oceanic route they would fly.

It was also decided that the crew who ferried the first aircraft to Kadena would fly the first operational sortie over Vietnam. The predetermined sequence would also include a fourth crew in the operational line-up, who rode a tanker to Kadena. Each SR-71 departure would be backed up by a spare (with the fourth crew), in the event of the primary aircraft having to abort due to No-Go discrepancies.

Two days before the Glowing Heat event – a codename reserved for SR-71 positioning flights – six tankers were flown to Hickam AFB, Hawaii. SAC codenamed the SR-71's KC-135Q tanker support Giant Bear. Initially three units were designated to perform this vital task: the 903rd ARS based at Beale, the 306th ARS at McCoy and the 909th ARS at Kadena. On 1 July 1971, support was increased to four squadrons, the 9th and 903rd ARS at Beale, the 306th ARS at McCoy and the 70th ARS at Little Rock.

According to an unclassified SAC history, the first KC-135Q deployment to Southeast Asia involved ten KC-135Qs relocating from Beale AFB to Kadena AB between 27 September and 30 October 1967. As each KC-135Q arrived at Kadena AB, a local KC-135A would depart for the 4258th SW at U-Tapao RTNAB. These first KC-135Q missions from Kadena AB were reportedly 'bomber refuelling missions'. In fact, KC-135Qs were quite active throughout 1967 in the trans-Pacific deployment of the A-12s to Kadena AB. The first A-12 overflight mission of North Vietnam, Operation Black Shield, took place on 31 May 1967. CIA pilot Mele 'Mel' Vojvodich flew A-12 Article 131 (60-6937) over Hanoi, Haiphong, and Dien Bien Phu (Mel had previously flown RF-86F Haymaker overflights of the USSR and PRC). The mission required a pre- and post-overflight refuelling with KC-135Qs. Given that this was four months *before* the first SAC-acknowledged deployment of KC-135Qs to Southeast Asia, it is clear that either SAC historians were unaware of the CIA A-12 mission support or they were publishing disinformation. 'Bomber refuelling missions' indeed! The final A-12 Black Shield mission was on 8 March 1968. A-12s had also overflown North Korea three times in 1968 during the USS *Pueblo* incident, and all of them used KC-135Qs for air refuelling.

The SR-71 crews agreed to draw straws, leaving the choice of who would go first in the hands of fate. Dave Dempster held the four straws of varying lengths and the RSOs from each of the other three crews drew one. With the luck of the draw, Dave Jensen's straw decided that he and Buddy Brown would fly the first aircraft across the Pacific and hopefully the first 9th SRW ops sortie from Kadena. Jerry O'Malley and Ed Payne would fly the second deployment and

Bob Spencer and Ruel Branham the third. Dempster was left holding the short straw, so he and Jim Watkins would ride the tanker unless one of the other crews came up with a 'sick jet'.

Command of the Operating Location would be alternated between the 9th SRW's wing commander and vice commander (and later the deputy chief of operations). The first detachment commander would be the vice commander, Col Charles Minter, and Col Carl Estes would be the director of maintenance. With the tankers safely at Hickam AFB, Maj Harlon Hain (the 1st SRS operations officer) set up a down-range radio station on Wake Island to provide emergency radio coverage. All was now ready for Brown and Jensen to make a record-breaking five-hour flight across the Pacific, the sortie being flown at a speed twice as fast as the existing world record.

DEPLOYMENT

At 10:00am on the morning prior to their departure, Brown and Jensen (along with their back-up crew, Watkins and Dempster) received their pre-mission briefing. Since this was the 9th's initial deployment outside the US, the briefing was attended by the wing commander and many others. Mission planners briefed the entire flight profile for the sortie, which would begin at 11:00am on 8 March.

After take-off they would head west from Beale to a point 50 miles north of San Francisco, where they would light the burners for a dash to 75,000ft to check that all systems were functioning normally before descending to the first air refuelling. With a clean bill of health on the Habu and a top-up of fuel from the tankers, Buddy and Dave would race to another refuelling northwest of the Hawaiian Islands, where they would 'buddy cruise' with the tankers for half an hour to take them to a point where they would be 'single-engine capable' to the island of Iwo Jima as an emergency landing base.

After the mid-Pacific refuelling, a third Mach 3.0 dash would take them to their third and final top-up west of Wake Island, where a maximum off-load would give them enough fuel to reach Kadena and go to an alternate base on Taiwan should the weather deteriorate over Okinawa. During the briefing they were informed that the weather was expected to be good in the refuelling tracks, at Kadena, and at their emergency landing bases, and that they could expect a comfortable crossing. After a maintenance briefing and some good humour, the two crews began official crew rest.

At 07:30am the next morning the four crewmembers reported to the PSD for a final weather briefing and a maintenance report on their aircraft. This was followed by the standard pre-flight physical examination and high-protein/low-residue breakfast (steak and eggs, and orange juice). After one last trip to the urinal, suit-up began. Two PSD suit technicians aided each crewmember as he donned his full pressure suit. A communications check and pressure suit integrity test confirmed that each garment was functioning properly, and after a 10-minute nap the crews were transported to their respective aircraft – Brown and Jensen to '978 and Watkins and Dempster to '980.

After 'strapping in and connecting up' they began the normal 'challenge and response' cockpit checklists, which took them through engine start, taxi and pre-take-off procedures. With engines revved to full military power and all instruments 'in the green', Buddy released '978's brakes and lit both burners, the SR-71 rapidly rolling down the Beale runway and lifting off into the vivid blue morning sky. He recalls:

> After crossing the coast of California, I started our transonic acceleration climb profile to altitude. This portion of the flight was considered mission critical because the spikes, forward and aft inlet doors, inlet guide vanes, and nozzles all had to check out prior to committing the 'bird' to the Pacific high-flight. Everything was 'up tight' so we were on our way. We again accelerated on our next leg to the third and final refuelling. Approximately 20 minutes after level off at 79,000ft, I encountered a problem that could have forced me to land at Johnson Island. My right spike (for no apparent reason) went full forward, which caused a very large yaw moment (lots of drag). I checked my cockpit over and found a popped circuit breaker, which (when reset) brought the spike back to its normal 'bottomed' position for high Mach flight.
>
> The third decel, AR and climb were also normal, but when we were back at altitude I encountered another potentially serious problem. My left generator went offline and I couldn't reset it. This was a No-Go situation, which meant I should land as soon as practical. My decision was to continue on because we were less than 1,000 miles (about 30 minutes) from Kadena. I used my coded call sign and contacted 'Mamma' and informed them that 'I was lost, but making good time'. We landed at Kadena with the failed generator, but the first SR-71 had already arrived and was soon ready to start reconnaissance operations in Southeast Asia and wherever else the national authorities might require.
>
> We had taken off from Beale at 11:00am and arrived at Kadena at 09:05am, nearly two hours earlier than take-off time (but in the next day because we had crossed the international date line). We beat the sun by a good margin.

Two days later O'Malley and Payne delivered '976 to OL-8. They had departed

Beale much earlier in the morning and landed at Kadena at 03:30am Japan time. Spencer and Branham delivered ’974 on 13 March. Three days later the KC-135 carrying Watkins and Dempster arrived at Kadena. It was late in the evening and raining hard when the tanker unloaded its weary passengers. As the last two SR-71 crewmembers stepped from the tanker to what should have been a rapturous welcome from the others, they were met by a junior NCO who was there to drive them to their visiting officers’ quarters in a blue Air Force maintenance van. The newcomers felt deflated as the NCO murmured a weak apology for the sparse turnout, dismissing it as ‘high workload due to operational requirements’. As they opened the door to their visiting officers’ quarters (VOQ) room, they were greeted by the entire gang of crewmembers and senior staff, who cried out the raucous wartime welcome, ‘Hello assholes. What took you so long getting here?’ OL-8 was now fully manned and it was time for a ‘little celebration’.

The Kadena detachment was known as Operating Location 8 (OL-8), which followed the numerical designation pattern of SAC’s overseas reconnaissance locations. It was redesignated OLRK (Ryukyu, the name of the island chain that includes Okinawa, and distinct from the four-letter ICAO field identified RON) on 30 October 1970, then changed to OLKA on 26 October 1971, changing yet again, to Detachment 1 of the 9th SRW, in August 1974, a title which it retained until 1990 when the SR-71 fleet was retired.

The operational deployment of the SR-71 to Okinawa also led to the aeroplane’s Habu nickname, after a dark, poisonous pit viper indigenous to the Ryukyu chain. Although the nickname Blackbird has long been publicly associated with the SR-71, it has been shunned by crewmembers and others closely connected with the Senior Crown programme, who favour Habu. The name stuck, and Dave Jensen designed a colourful detachment flight jacket patch with the snake interlaced around the figure eight.

Colonel Charlie Minter was the chief architect of most of the operating procedures for OL-8’s crews. Those rules proved so sound and well structured that the majority of them remained unchanged throughout the entire 22-year-old life of the Kadena operation. Maintenance teams from the 9th SRW that manned OL-8 were the best at their jobs and considered the cream of Air Force maintainers. Col Carl Estes’ hand-picked Habu technicians had done high-priority work on the three jets as they arrived and had all of them ready for operations by 09:00am on 15 March 1968, when the unit was declared ‘fully

OR' (operationally ready).

On Monday 18 March, OL-8 was ordered to fly its first operational sortie. As previously agreed, Buddy Brown and Dave Jensen began preparing themselves for the mission. As a hedge against crew illness or aircraft system failures every operational sortie was backed up by a spare aircraft and a suited-up aircrew who were equally prepared for take-off orders. The standby crew on this occasion was Jerry O'Malley and Ed Payne. Although everyone was 'all set' for the mission, it was cancelled by higher authorities and Buddy and Dave flew a 'Cathy' training sortie instead. As previously agreed back at Beale, the next crew to fly was Jerry and Ed.

TO WAR

On the morning of Thursday, 21 March 1968, Maj Jerry O'Malley and Capt Ed Payne completed the first operational mission of the Senior Crown programme, in '976. The aircraft was equipped with a SLAR in the nose section, a downward-looking, vertically mounted TROC for ground track verification, and an AR-1700 radar recorder in the N-bay, within the right chine. Behind the cockpits in the P and Q-bays were the left and right long focal length 'close-look' TEOCs. Finally, bays S and T accommodated two OOCs.

Having topped up the fuel jet's tanks shortly after take-off, Jerry accelerated and climbed '976 to speed and altitude before penetrating North Vietnamese airspace in a so-called 'front door' entry over the port of Haiphong. The route was virtually identical to that flown by Mele Vojvodich in his Oxcart ten months earlier. The Air Force crew flew over Hanoi before exiting via Dien Bien Phu, having spent just 12 minutes in hostile airspace. Jerry then decelerated and descended into the designated refuelling track in Thailand.

Craven 'Gibb' Gibbons, flying the lead tanker, timed his turn to perfection just as '976 arrived at 25,000ft, a few miles behind and 1,000ft below the KC-135Qs. A split fuel load from the two primary tankers filled the SR-71's tanks, ensuring that the services of the third, spare tanker wouldn't be required.

The Habu, a poisonous viper indigenous to Okinawa and from which the SR-71's nickname was derived. (Paul F. Crickmore)

O'Malley then repeated the climb and acceleration routine up to their prescribed altitude, on track for the second and final take of the mission. This run was to be flown over the demilitarized zone (DMZ) between North and South Vietnam, the primary objective being to locate the heavy guns and supporting infrastructure that were involved in the North Vietnamese siege of Khe Sanh.

For this run, the primary sensor was the SLAR, which could penetrate the heavy jungle canopy, but when Ed Payne had earlier conducted a BIT test of the system it had failed. He reasoned that no damage could be done to the system if he positioned it manually and took some shots on the off chance that it would find something. With the run complete, the jet exited the sensitive area and the crew made their way back to Okinawa.

Inbound to Kadena they were informed by approach control that the base was fogged in. After further discussion it was agreed that an approach could be flown in an attempt to conduct a visual landing. Using ground-controlled approach radar assistance, Jerry descended as low as was prudent into the fog – the crews on the ground reported he was below the tops of the tanker tails, just 30ft above the ramp. Although the approach was good, Jerry was unable to locate the runway and therefore conducted an overshoot.

Low on fuel, he called for the standby tanker that had been launched earlier just in case the weather at Kadena turned nasty. After link-up, he took on 25,000lb of fuel while Ed copied a two-figure encoded number that told them their divert airfield location, Ku Kuan on the island of Taiwan. Two additional

KC-135s were launched to accompany ’976 to nationalist China, the SR-71 adopting a tanker call sign as the number two aircraft in a three-ship formation. This deception was undertaken to hide the inter-island diversion from SIGINT monitors on the Chinese mainland. As the Habu made its way ‘low and slow’ with the tankers, the destination airfield’s non-directional beacon returned the unexpected Morse code identity signal CCK. The tanker crews soon resolved this problem – it turned out that Ku Kuan had recently been re-named Ching Chuan Kang.

Jerry asked the CCK tower for permission to land and made a straight-in visual approach at 175kt before performing a smooth touchdown. Clearing the runway, Jerry lined up close behind the lead tanker with the second KC-135 tucked up behind as they taxied to the parking area. This unusual sight caused considerable confusion among the tower personnel, particularly when one controller asked for the call sign of ‘the little black aircraft between the two tankers that replied with a tanker call sign.’ While Ed was talking to the tower people, Jerry dialled up the radio frequency of the SAC command post that had recently opened on CCK and asked for the aircraft to be hangared for security reasons.

Since CCK was a PACAF joint-tenancy base with the Chinese Nationalists, most of its hangars were filled with C-130 Hercules transports. To clear a secure spot for the SR-71, a C-130 up on jacks had to be rapidly lowered back onto its undercarriage and rolled out of a hangar. The work took 30 minutes, which left the SR-71 standing in full public view close to the base perimeter fence, its engines still running. A crowd of at least 500 Taiwanese gathered 10 to 15 deep along a 300-yard section of the fence, fascinated to see such a futuristic jet standing on their airfield and almost within touching distance.

With the Habu safely hangared and a security cordon thrown up around the area, the ‘take’ was downloaded and flown to the 67th RTS at Yokota for processing (this 67th continued working with OL-8 until 29 March 1971, after which the 548th RTG, a PACAF unit at Hickam AFB, Hawaii assumed the processing responsibility). The SLAR imagery was sent to Beale for processing by the 9th RTS, before being sent on to Washington DC for analysis by national-level agencies.

After two nights at CCK, the crew and ’976 were ready for a ferry flight back to Kadena. The unrefuelled hop was uneventful, but the reception from their friends and colleagues back at base was memorable. The post-mission intelligence results were also quite stunning.

The SLAR that Ed had manually programmed had indeed worked. Its take revealed the location of the heavy artillery emplacements around Khe Sanh, and a huge truck park that was used in support of the guns; both sites had eluded sensors on other US recce aircraft. Within days of receipt of this intelligence, air strikes were mounted against both targets, reducing their effectiveness dramatically. After a 77-day siege, Khe Sanh was at last relieved on 7 April 1968 (two weeks after '976's 'discovery' sortie). As a result of their significant contribution to this highly successful mission, Maj Jerome F. O'Malley and Capt Edward D. Payne were each awarded the Distinguished Flying Cross. On its very first operational sortie, the aircraft had proven its value, as it would on thousands of other occasions over the coming years.

EYES AND EARS

Shortly after their arrival on Okinawa, the crews were summoned to a briefing in a secure room, where they heard of local efforts to observe their activities. Since the primary building material of Japanese houses was wood, tall watchtowers had been built in numerous locations on Okinawa to detect fires in their earliest stages so the local fire departments could quickly contain them. One such tower existed just outside the perimeter fence on the north side of Kadena AB, near Kosser Circle. The so-called fire guards had unrivalled views of the entire base from its commanding platform.

During the year of A-12 operations, intelligence officers had correlated positively that whenever an A-12 emerged from its hangar, a red flag was run up the watchtower's flagpole. In addition, it had been ascertained that within five minutes of the flag's lofting, a Soviet 'trawler' (on radar picket duty just beyond the 12-mile limit off the coast of Okinawa) switched on its radar, which remained on as long as the flag remained flying from the tower.

All along the China coast to the Gulf of Tonkin the Soviets had positioned a string of such 'trawlers' to relay tracking information on the Vietnam-bound Habus. An RSO later commented that it was almost like radar coverage back in America, but instead of FAA air traffic centres handing off from one ATC centre to another, the Soviets were monitoring every move. The coordinated tracking was also supported by Chinese 'Tall King' surveillance radars along the country's coast and on Hainan Island.

As an A-12 or SR-71 penetrated North Vietnamese airspace, the first SA-2 target acquisition radars would lock on at a slant range of approximately 80 miles. Such monitoring activities caused one crewmember to contemplate a radio transmission on the emergency frequency, saying in Russian 'Good Morning, Comrade'.

What these crews were not told was that US intelligence services had broken the Communists' communications codes. Lacking landlines for point-to-point telephone contact, the Vietnamese had to transmit Habu tracking data to their command centres via broadcasted radio frequencies, which were immediately intercepted by US listeners on Okinawa, Taiwan, South Vietnam and Thailand, as well as by SUN VALLEY II C-130B-II airborne listening posts flying over the Gulf of Tonkin. Fluent Russian and Chinese linguists working at these stations would translate the broadcasts into English for secure onward transmission to various allied agencies.

Back at Kadena, a handful of senior officers were privy to that information and could indirectly monitor their aircraft's progress via the enemy's conversations. As an A-12 or SR-71 departed Kadena on an operational sortie, the commander and a few of his key staff members would meet in the Special Activities Office, where a secure teleprinter known as a 'Dingy Whopper' would tell them about the sortie. As one officer described this 'mail reading' exercise, 'We were able to listen to them while they watched us.'

Fate was to intervene and frustrate the other Habu crews who prepared to fly their own first operational sorties, each being cancelled and replaced with a training sortie instead. On 10 April 1968, Brown and Jensen were once again set as primary crew. O'Malley and Payne were suited up as backup. Buddy cranked '974's engines precisely on time and taxied out of the Little Creek area to run up near the end of the runway. Jerry and Ed were sitting in '976 waiting to hear that Buddy and Dave were off and running.

Instead, Crew Chief Tech Sergeant Bill Campbell told them that '974 was taxiing back to the hangar. While Jerry and Ed were getting ready to roll, Buddy and Dave parked '974 nearby, the stricken jet being swarmed over by most of the OL-8 maintenance force. Even Col Estes clambered on top of the jet with his ANS specialists and 'was working like a GI mechanic' to help replace the astro-inertial navigation set. Meanwhile Ed and Jerry were ready, as Ed recalled:

> We got out there and were running a fast checklist and I happened to look up and here comes Buddy taxiing like a bat out of hell. It must have been a world record ANS change, but I was certain that Dave hadn't had time to get a 'star light' because the system hadn't had time to go through all of its BIT checks yet. Charlie Minter, who was in the mobile control car, obviously was thinking the same thing. Since it was his duty as OL commander to put the best aircraft over the target, he leapt from the car and wrote 'YOU GO' on an 8×10in. pad that he held up to Jerry and I, and 'YOU STAY' on the other side that he showed to Buddy and Dave.

As they climbed away, Jerry and Ed elected to adopt the primary aircraft's call sign since they had made that aircraft's take-off slot. They reasoned that the tankers would be expecting that call sign and that they would minimize confusion by keeping '974's identity. Unfortunately, the call sign change did not help Bill Boltersiders in the CP, who had to dispatch a coded report to HQ SAC immediately after take-off. In his uncertainty as to which aircraft actually departed, he had to wait for Col Minter's return from the flight line before having the necessary details to set HQ SAC straight. The mission got off to a good start and Jerry and Ed were again on their way toward Vietnam, on the 'second' SR-71 combat sortie.

They coasted in near Saigon and made a shallow turn to the right to fly northbound across the DMZ towards Vinh and then on to Hanoi. There was no shortage of high priority targets: Phuc Yen and Ying-By airfields, the steel works, and dozens more. Unknown to the crew, President Johnson had stated that day in a broadcast that no US strike aircraft would fly further north than the 19th parallel. His decision had caused confusion within military circles as to the meaning of 'strike aircraft'.

The 'ground pounders' at higher headquarters decided to play it safe and sent out an HF radio message intended to withhold the sortie from overflight. Ed received a coded message to that effect from SAC's Sky King communication's system, over the international Giant Talk HF radio network, but was too busy flying at 33 miles a minute over the prime target area to take time to decode the message, which instructed them to turn left and abort the mission. Some moments later, the autopilot initiated a programmed turn that started them back towards the south. With a few moments between high workload events, Ed told Jerry of the abort order. After completing the turn, they exited North Vietnam near Dien Bien Phu and prepared for descent toward their air refuelling over Thailand.

E. PAYNE/O'MALLEY

Majors Jerry O'Malley and RSO Ed Payne completed the first operational Habu mission, in '976 on 10 April 1968. Airborne for 5.1hrs, they were forced to divert into Ching Chuan Kang Air Base on Taiwan as Kadena was fogged out. (USAF)

The two fliers' spirits had been high throughout the sortie, particularly since their good luck had enabled them to fly both operational missions performed so far. The mission had been 'a piece of cake so far', or so they thought, until Jerry eased back the throttles to the preassigned descent RPM. At that moment both engines rumbled slightly in a compression stall and immediately flamed out.

An air-start required 450kt KEAS and 7psi on the compressor face to get things 'turning and burning' again. That meant getting down to denser air where those higher values could be achieved. Jerry pushed the nose down hard and Ed recalled seeing the artificial horizon instrument showing all black. As they rode the aircraft down to lower altitudes they decided that if Jerry could not get an air-start, Ed would call 'Mayday' at 23,000ft and they would 'punch out' at 14,000. At 40,000ft Jerry gave the throttles a nudge, which gave the engines positive fuel flow and a shot of TEB for ignition. There was no response. He tried again as they were passing through 30,000ft. Still nothing. Ed recalled:

> By now we were both getting a little anxious. I saw the altimeter go through 26,000ft and I was getting set to say 'Mayday! Mayday! Mayday!' I got the word 'May' out when I felt the aircraft shake a little. Realizing that Jerry had finally got something going, I didn't finish the rest of the message. A glance at the altimeter showed us just below 23,000ft and still descending quite rapidly. Just then Jerry said, 'I've got one of them started.' Shortly afterwards he got the second engine fired up and when we hit 20,000ft we had both engines running fine.

Having received the 'May' of Ed's message, the tanker crews knew that all was not well with the Habu crew. This realization was confirmed as they monitored the air-to-air TACAN's distance measuring equipment (DME) ranging. Ordinarily the SR-71 would make a 'hot' rate of supersonic closure on the tankers, slowing notably only in the final 30 miles. The DME meter would normally be clicking over between 20 to 30 miles per minute during the early part of the deceleration. Instead it quickly slowed to a closure rate of about 8 miles per minute. That speed meant the Habu was low and slow well before intended and way up in 'bad guys' territory. Ed remembered:

> We got our act cleaned up and the first transmission we received from the tankers was, 'Are you guys okay?' I answered, 'No'. They asked, 'What can we do?' I answered, 'Turn north'. The double-engine flameout and rapid descent profile had left '976 down at a 'gas-gobbling' 20,000ft over northern Laos, some 300 miles short of our planned ARCP. We climbed back to 26,000ft and headed south. I recall that the lead tanker navigator was a woman. I'm sure they must have violated operating procedures coming that far north without some form of fighter cover, but we were damn glad to see them.
>
> By the time we reached the tanker, '976 was below 8,000lb of fuel. The tanker turned in front of us and the boomer plugged into our AR receptacle in a heartbeat. We drained 80,000lb of JP-7 out of two tankers and even used a little from the spare – perhaps a record off-load. We used the extra gas because we had to lengthen the air refuelling track from Laos to mid-Thailand. Had we just filled up and climbed for home we wouldn't have been able to fly the profile properly, so we just stayed behind those beautiful tankers until we reached the originally planned disengagement point.

While Jerry and Ed were refuelling, they discussed what might have caused the double-engine flameout and what would be the preferred action to get home safely. Ed was in favour of staying with the third KC-135 until they met some Kadena-launched spare tankers. Jerry, on the other hand, believed they should fly a normal profile to help determine the cause of the problem. Jerry discussed at length what data he wanted Ed to record, and just prior to the final decel back into Kadena he began reading out RPM, EGT and fuel flow information. He eased back the throttles and the engines spooled down normally. They recovered into Kadena without further incident, thus ending the second operational sortie of the SR-71's reconnaissance career. That double flameout foreshadowed a spate of similar problems that would follow over Laos, earning the Habu the new nickname 'Lead Sled' back at the SAC Reconnaissance Center.

With the first two ops missions under their belts, Jerry and Ed were relegated to flying test hops for the duration of their tour to ensure that the other crews had an opportunity to accumulate combat time. The following week Buddy Brown and Dave Jensen were scheduled to fly a double-looper over North Vietnam. They got airborne in '978 at 11:00am on 18 April and all went well until it was time to decelerate for their first Thailand refuelling. The tanker notified them that the ARCP had been moved due to thunderstorms in the AR area. As they began to decelerate, the left generator went offline and could not be reset. This failure was followed by a double engine flameout. Dave transmitted the necessary codes stating that they were going to make a precautionary landing at Takhli Royal Thai Air Force Base (RTAFB), since generator failure was a 'land as soon as practicable' abort item.

Without power they lost cabin pressurization and their 'moon suits' inflated, which made cockpit movements awkward. As they descended towards an altitude where the engines could be restarted, Buddy requested that the tankers come north to give them additional fuel after the early and rapid descent. At 35,000ft he was able to restart the engines. He then adjusted the aircraft's centre of gravity for subsonic flight and called Takhli approach control, informing them of their impending arrival. The tower controller told them that the tankers had already alerted the CP and they were ready to receive them. On approach, the nose gear's down-lock light failed to illuminate. Buddy made a low pass by the tower to have the gear visually checked 'down' and then circled to an uneventful landing.

The CIA had a secure compound on the airfield from where it conducted U-2 operations and Buddy was able to use one of its hangars. A recovery team arrived from Kadena and readied the SR-71 for its return. As they were preparing to depart, the head of the Agency's detachment told Buddy, 'If you don't tell anyone you were here, I won't either.' Buddy laughed at the 'typical cloak and dagger' remark and thanked him for the first-rate support on their interrupted Habu mission.

On 27 April, Buddy and Dave flew their second ops sortie, this time in aircraft '976. As they started their descent into Thailand, they experienced another double-engine flameout and another failed generator. As they taxied back into the Agency's hangar at Takhli again, Buddy insisted he had not come to join the CIA, but to enjoy their hospitality. On leaving the Thai base two days later, Buddy saluted them with a 'max burner' climb out that 'left them all smiling', the lightly fuelled Habu climbing steeply away from its newfound second home in South-East Asia.

O'Malley and Payne ferried '976 to Kadena AB on 9 March 1968. Before being ferried back to Beale six months later, it had chalked up ten operational missions over North Vietnam. (USAF)

Tracking down the generator issue required diligent detective work by Col Carl Estes and his maintenance team, because on the ground the generators worked perfectly. It was eventually discovered that prolonged heat soaking at cruise speed was melting the solder that secured wires running from the generators. Back on the ground the aircraft cooled, the solder solidified and the generators came back online. Having identified the problem, the fix was simple; the wires were connected using solder with a much higher melting point.

Following cancellations and disappointments, Jim Watkins and Dave Dempster finally got airborne on 19 April in '974. They topped off their fuel tanks near Kadena and headed out for North Vietnam. Arcing around Hainan Island on their right, they entered the Gulf of Tonkin and reversed left onto their penetration track. This front door entry took them over Haiphong and Hanoi, exiting via Dien Bien Phu.

As on the earlier flights, everything went well until it was time to come down for aerial refuelling. As soon as Jim slid the throttles out of burner, there was an enormous bang, followed by another double flameout. He got both engines started up again after wiping 50,000ft of altitude off the altimeter's reading. The tanker crews responded immediately to the emergency call, heading north without fighter escort into the 'bad lands' of Northern Laos.

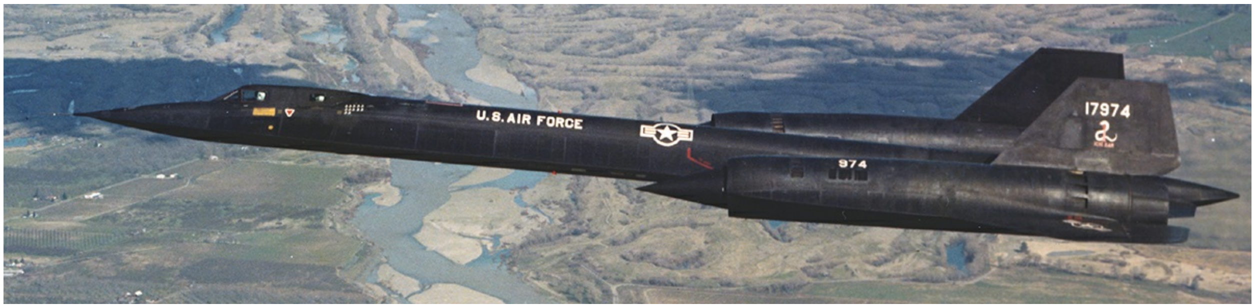
While the Habu was on the boom taking on three tons of fuel a minute, Jim had time to reflect on the incident that could have ended in disaster. At that point he said to his RSO, 'Davey, I think I might know what happened and if I hold a couple hundred more RPMs above what it says in the checklist the next time I come out of burner, I might be able to keep the engines alive and we can complete the mission. What do you think?' Dave replied, 'Let's give it a try and do the next run.'

It seems that 'cowboy' Jim Watkins had the first glimmer of an idea that would later be proven when Don Walbrecht and Phil Loignon flew Vietnam to Thailand descents without a problem.

In 1968, OL-8's operational rate was approximately a mission a week. Jerry O'Malley and Ed Payne rotated home earlier than originally planned and were replaced by Maj Larry Devall and Captain Clyde Shoemaker. Maj Bob Spencer and Maj Keith Branham flew their first operational sortie in aircraft '974 on 22 April: it was a double-looper over North Vietnam lasting 5.5 hours. They were airborne again on 5 May, flying another double-looper, this time in '978, and again the duration was 5.5 hours. The third and final operational flight of their first tour took place six days later.

On 13 May 1968 Jim Watkins and Dave Dempster flew '974 on a two-loop route over North Vietnam using side-looking radar. While on the KC-135's boom during the final air refuelling before the flight back to Kadena, Jim set the cabin pressure altitude switch to 10,000ft. He told Dave he was raising his faceplate for a drink of water. This was an unusual procedure, momentarily breaking the old flying rule 'oxygen over 10,000ft'. After a refreshing libation, Jim closed his visor and informed Dempster that he was ready for the flight back home.

Major Don Walbrecht has his necktie cut by CMSgt Gornick wielding a miniature samurai sword after successfully completing his first operational mission over North Vietnam in '978, on 25 May 1968. It was a ceremony that became a Habu tradition. (USAF via Don Walbrecht)



'974 completed 14 operational missions on its first deployment to OL-8 before returning to Beale on 16 September 1968. It's seen here sporting 12 Habu mission marks behind the RSO's cockpit, also note the Habu coiled around the number '1' and ichi ban (number 1), written below. (USAF via Tony Landis)

Dropping off the boom, he lit the burners and headed up into the darkening tropical night sky. When he was established in an accelerating supersonic climb, Jim engaged the autopilot's auto nav function as the Habu headed northeast over the South China Sea. It was during this stage of the climb that Dave first perceived that all was not well with his pilot. Jim's words were beginning to become slurred, but as far as Dave could tell, his actions were still okay. However, they had trained together as a crew for well over 100 hours and the RSO was becoming increasingly concerned.

As the climb continued, Jim's speech deteriorated further. Then the gut-twisting reality of the situation hit Dave with full force: his pilot was hypoxic and the RSO had no flight controls to overcome impending disaster. In a matter of minutes Jim would lose consciousness and shortly thereafter (unless Dave could get oxygen into his pilot's lungs), Jim would die and Dave would have to bail out in the vast South China Sea. The latter was not a realistic option for the RSO, and he wondered how he could get Jim's attention.

Luckily the autopilot and auto-nav functions were engaged, which allowed Dempster to exercise the only control inputs that an RSO had from the back seat of an SR-71: lateral steering using nav steering commands, but with absolutely no pitch controls. Dave dialled up 7700 on his IFF panel and squawked 'emergency' to alert the radar watchers in South Vietnam who were monitoring the flight that there was a problem.

One option Dave considered was to turn the aircraft towards Cam Ranh Bay (the large PACAF base on the coast of South Vietnam). He dismissed this idea almost immediately, for in a turn there was a greater chance of an inlet unstart and it was very doubtful if Jim could control the aeroplane in his current state of consciousness, which had become further degraded during the last minute of flight.

Turning towards Vietnam would also have taken the aircraft closer to the 'bad guys' and Dave was determined that he would not leave his pilot or allow any part of 'his' SR-71 to fall into enemy hands. By now Jim was on the edge of unconsciousness. There was perhaps one possible remedy to the situation. Dave summoned up every ounce of command authority in his voice and yelled over the intercom in a clear deliberate manner that 'We are now at the Start Descent checklist. Inlet guide vane switches to lockout.' Surprisingly, Jim flicked the switches. 'Inlet Controls – Auto and Close.' Jim complied. 'Throttles, 720°.' Again, Jim carried out the RSO's instructions. Slowly '974's altimeter began to unwind. Dave recalled:

> Jim was one hell of a pilot. All of those thousands of hours of flying and training (and here he was about to pass out) and yet he was doing exactly what he was instructed to do. He came out of afterburner; he set the correct RPM and then threw the right switches for the bypass doors. Luckily, we didn't flame out or unstart, and thank God, he didn't disconnect the auto-nav system, so it was still steering us very accurately.
>
> On the way down I monitored my triple display indicator (Mach, KEAS and altitude) readings and by using the profile card that we used to rendezvous with the tanker, I was able to give Jim additional commands like, 'Okay, Jim, you're doing great, just ease it down a little bit, ease it down. Adjust your RPM slightly. Okay, you're right on profile.' He was a disciplined flier and seemed to respond to those commands, and by the help of God, we raggedly descended and decelerated all the way down to subsonic speed and he didn't pass out.
>
> We levelled off at about 25,000ft and cruised at that altitude for a while, where Jim regained a bit

> of his normal consciousness. Slowly, Jim's voice began to return to normal and he suddenly said, 'What the hell are we doing at this altitude!' I said, 'Okay, Jim, the first thing I want you to do is to open your faceplate and close it again, and check that your bailer arm is down and firmly locked.' He did exactly what I instructed and then started swearing at himself because the picture was beginning to return to him what had happened in the last ten minutes. We stayed 'low and slow' until he appeared clear and sharp again.
>
> I calculated that we had enough fuel to fly subsonic all the way back to Taiwan, but Jim convinced me that everything was fine and that he clearly understood what had happened to him, although he had no real recollection of what had transpired during the 10-minute descent. Feeling comfortable that Jim now knew what was going on, I took the IFF out of emergency and he lit the burners and we flew supersonic to Kadena. One thing is for sure, you don't fly anywhere at Mach 3.0 and arrive at your destination 15 minutes late.

Col Minter and a few of the other SAO-watchers knew that something had happened, but no one knew what it was until the debrief (behind closed doors) when the problem was discussed in detail.

The initial rebuffs aimed at Jim soon gave way to more constructive dialogue when those who had not flown began to realize just how fortunate the crew of '974 had been. If Jim had not responded exactly as he had to Dave's instructions, the aircraft and crew would have vanished into the sea and the Habu loss may have remained a mystery. It was therefore agreed that no disciplinary action would be taken and the story would be suppressed (which it was, for 25 years).

As the experience of triple-sonic reconnaissance continued, crew changeovers brought other pioneers into the combat line-up at Kadena. In early May 1968, Maj Don Walbrecht and Capt Phil Loignon arrived to make their mark in operational flying. Their eight sorties from Kadena were typical of those flown at the time, and, in contrast to most of the initial missions flown in March and April, went quite smoothly. Like all crews, they started off with a two-hour training flight south of Okinawa in '976, on 19 May 1968, to get the feel of the vast oceanic area of the western Pacific.

Six days later they were airborne in '978 on their first North Vietnamese sortie, which lasted 5.25 hours. Completing the standard post-take-off refuelling, they were determined not to abort their mission unless 'a wing fell off'. Back in the US, Don and Phil had experienced few inlet unstarts, but on their first important ops sortie while approaching Mach 2.4 and 55,000ft one of the inlets let its shock wave go with an almighty bang. Phil asked, 'Isn't that a mandatory abort item?' 'Isn't what an abort item?' replied Don. They pressed on to 75,000ft; the inlets kicked and bucked a few more times but all was smooth as glass when they arrived at Mach 3.0. After entering the Gulf of Tonkin, Don pressed on to Mach 3.2 thus presenting the SA-2 crews an even more tricky intercept solution.

Coasting in over Haiphong at 79,000ft, they cruise-climbed to 81,000, where Phil noted a SAM target-acquisition radar locking on. Immediately his ECM equipment nullified the threat and no missiles were fired. After crossing Hanoi and flying close to China, they exited North Vietnam over Laos, where Don eased the throttles out of burner for his descent (well aware of O'Malley, Brown, Watkins and Devall's double flameouts). Immediately there was a low rumble (the onset of an inlet/airflow mismatch, which had probably caused the spate of flameouts). Instinctively, Don eased the throttles slightly forward, adding an additional 200RPM to the engine speed. The rumble instantly disappeared and the engines remained alight for a notably smooth descent.

Don accelerated and climbed '978, by now decorated with Playboy rabbit artwork, on a southerly heading, rounding South Vietnam for another northbound run. They charged back up the Gulf of Tonkin, offset from their first pass to make another uneventful run and a smooth deceleration at the slightly higher power settings, the mission terminating (after refuelling) in an uneventful recovery back to Kadena.

They were airborne again the next day, taking '978 on a functional check flight to verify inlet performance, and again on 8 June, in the same jet to maintain aircrew currency. They completed their second operational sortie in '974 a few days later, with a 4.5-hour 'single looper' over North Vietnam.

Their third mission was again in '978, on 30 June (a two-looper lasting 5.5 hours), for which they were each awarded the Distinguished Flying Cross. Don explained:

> Phil and I flew this important sortie in the face of a great typhoon, which was positioned off the southeast coast of Vietnam. It was extremely impressive to see from high altitude, easily visible from more than 500 miles away. Phil and I completed our two passes over denied territory and were heading back towards Kadena. By this time the typhoon had moved closer to the land mass of Vietnam and pulled a great deal of moisture into its system. It was a remarkable sight, this enormous boiling maelstrom of clouds stretching out before us, with vast columns of thunderstorms forced upwards on convective currents of air rising along its forward spiralling arms.
>
> The exceptionally tall storms looked like giant turrets guarding this mass of moving energy. Unable to see the storms that were lined up ahead of us, Phil was concerned that we might have to fly through the tops if they reached above 70,000ft. When we got closer, we could see that we had the better of them by at least 5,000ft. Flying at Mach 3.0, 15 miles up, one rarely approaches any other object closely enough to feel the spectacular sensation of 'great speed'.

> The typhoon had acted like a giant vacuum cleaner, drawing moist air away from the land mass and into the storm. The result was high quality, clean air over all of the target areas, allowing us to obtain outstanding resolution of the 400 important targets Phil's cameras photographed.

Don and Phil were especially proud of having been able to provide such a high-quality take, but they modestly maintained that it was just good fortune that they happened to be airborne on such a good day, and that any crew back at the OL could have brought home the 'goods'. Thanks to the typhoon, Vietnam, China and Laos were all unusually clear and they got the 'good-goods', which saturated the attention of photo interpreters at all national and theatre intelligence centres.

On their final ops sortie in their 'always-in-the-green' '978 on 23 July 1968, Don and Phil flew another important double-looper, lasting five hours. It yielded yet another superb quality take thanks to the proximity of 'the granddaddy of all thunderstorms', which squatted over Haiphong. Don explained:

> Phil and I came zipping back up the Gulf clearly seeing all of Hainan and a great piece of China on our right. To our dismay, it appeared that too many clouds loomed ahead for a good run. I could see a great mass of high clouds standing over our target with a storm pillar billowing up out of its middle – it was the superdome of a single massive semi-tropical thunderstorm. I said to Phil, 'it looks as if our sortie is going to be ruined by all of the undercast.' We pressed on hoping for the best, accelerating and climbing to Mach 3.2 and 80,000ft to make the run. By the time we topped out, we were beginning to cross over the storm, just barely above it.
>
> My attention was riveted on the billowing top, which must have extended up to 79,000ft – surely one of the highest cloud formations ever reported. We made a slight turn to the left to stay on track and went right over the top of the grand storm at an absolutely incredible rate of passage. Momentarily, I could feel the disturbing effects of the rising atmosphere's convective instability that made the Habu wallow around more than I'd ever experienced at that high an altitude. As we shot over the top of it, the landmass ahead was sparklingly clear with perfect visibility all the way to mid-China. Phil photographed all of North Vietnam and much of southern China, and we turned south over Laos descending on our usual tanker track near Korat, Thailand. Again, there were lots of medium-sized thunderstorms over Thailand, but we found the tankers right where they were supposed to be.

BEVACQUA/CREW

Majors Tony Bevacqua (left) and his RSO Jerry Crew had the dubious distinction of being the first SR-71 crew fired upon by SA-2s. (USAF)

> The tanker's boomer plugged into '978's receptacle immediately and the pilot started dodging all over the sky to avoid thunderstorms. It seemed we were heading west much longer than normal because of the sun's position and I recall looking out during a turn and asking Phil, 'What's all that water down there?' He replied that it was the Andaman Sea, near Rangoon in Burma. We finally headed back to the southeast and after filling our tanks I asked the tanker's navigator for a heading that would take us clear of the thunderstorms, to which he replied, 'There isn't one. You'll just have to take your chances.' We climbed and accelerated, luckily missing all the very turbulent thunder cells. After we got above 50,000ft and over the tops of most of the storms, we were in a continuous shroud of high thick cirrus, which extended to the mid-sixties.
>
> We were moving at Mach 2.6 when we blasted from the cloud tops. It was like being shot from a rocket as we bolted from the high tropopause into the clear stratosphere. We did another fast circuit of North Vietnam to see that the great single storm had already entered the post-mature phase with its anvil top flattened out farther below. We then descended back into Thailand where the other storms had been. We were pleased that they had softened and moved further west. Having completed our third refuelling, we raced back to Kadena for an uneventful landing. We flew our final Kadena training sortie, again in '978, shortly afterwards and redeployed back to California in the weekly Beale tanker.

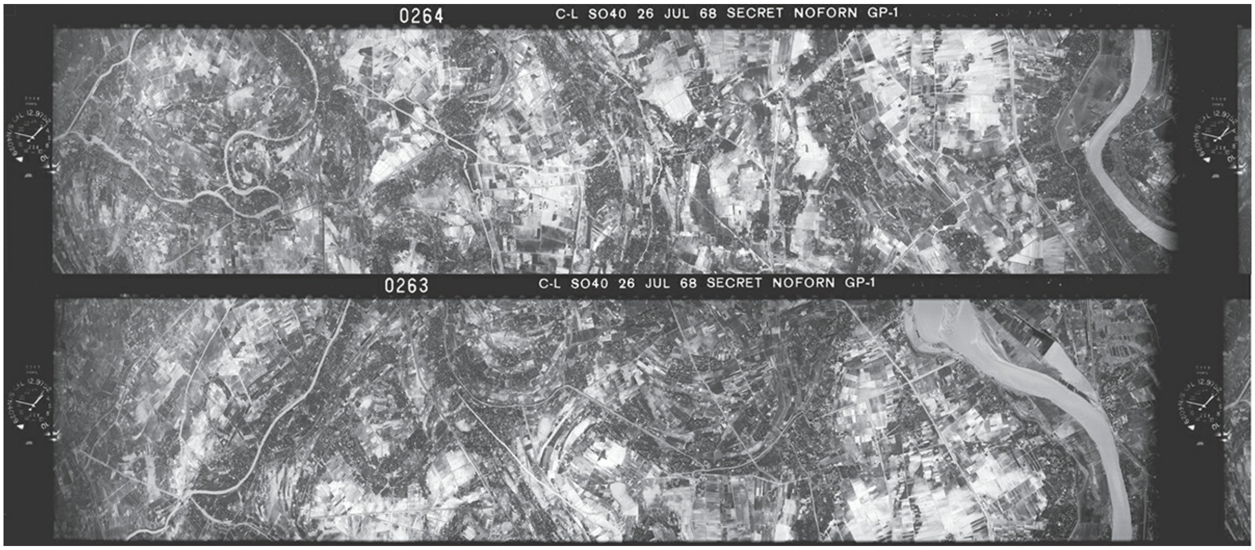
At just after 9:00am on 26 July 1968, Maj Pat Halloran and his RSO Maj Mort Jarvis launched in '974 for what was to be their first operational sortie. However, during the course of conducting a bit check on their DEF suite, Mort detected a systems failure. Since this was a No-Go item on the checklist, he continued to recycle the equipment in the hope that the problem would clear, but to no avail. With time running short, the crew finally had to admit defeat and literally just five minutes short of their mandatory time to call for the spare to launch, they had no option and made the abort call.

Consequently, at 10:08am Maj Tony Bevacqua and Maj Jerry Crew launched in '976 to replace Pat and Mort on the planned double-looper over the North. On their first pass, Jerry warned Tony that a SAM fire-control radar had locked on to them. Almost immediately he said, 'We've been fired upon'. The defensive systems performed as advertised, but Tony was unable to see the missiles, which ended up well behind them.

During refuelling, Jerry asked Tony if he intended to complete the sortie, since their next track would take them right back over the position from which they were fired upon. Tony replied, 'Why not? They missed us.' On the next pass there was no reaction from any SAM battery. Back on the ground at Kadena, Tony recalled, 'As we got out of the aircraft we knew the commander already knew about the incident. The first thing he asked was, "Did you see anything?" We said we hadn't, but we knew that it was for real. We were later told that the nearest of the two missiles was about one mile away.'

It was the first occasion in which an SR-71 had definitely been fired upon and, by chance, the terrain-tracking camera took a picture of the SA-2s, recording Tony's 'first' for the record books.

Pat and Mort launched in '974 two days later and completed their first ops sortie, a 5.3hr flight, flawlessly.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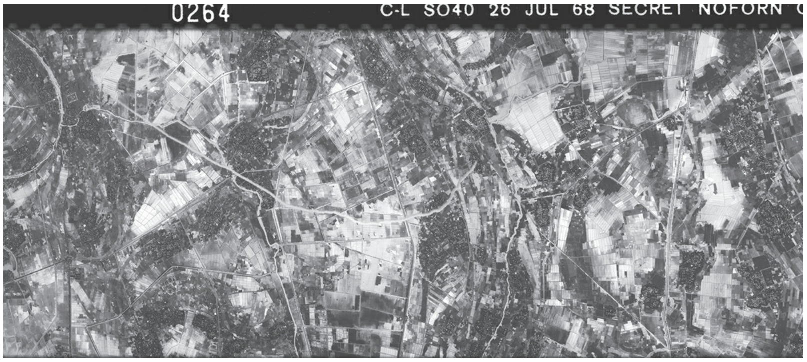
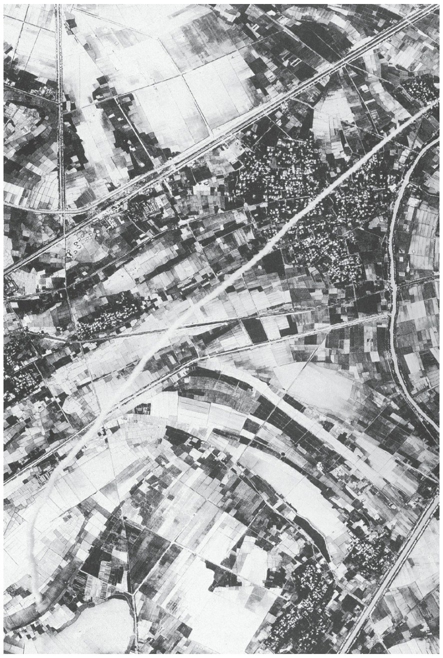




Three images taken from '976's OBC camera, and a fourth imaged by its TROC, showing the white exhaust trail marking the path of the first SA-2 to be fired at an SR-71 on 26 July 1968. Note the data block detailing time and aircraft position at the edges of the first two images. 0263 and 0264 at the top of the images indicate the frame number. (USAF via Lin Xu and Tony Bevacqua)

TRADITIONS AND ANTICS

All work and no play makes John a dull boy, so the saying goes. Habu crew certainly knew how to work and get their job done, and they most definitely could not be accused of being dull, especially John Storrie, Buddy Brown, Larry Devall and some of the more notorious pranksters. There was usually a genteel

Sunday afternoon daiquiri party in the commander's quarters, which were only about 100 yards from the 'O' club (Officers' club) where many evening activities began.

The favourite brew of one party group was 'Velvet Punch', so-called because it could knock you out gently. Craven Gibbons (a tanker pilot of Habu renown) was the undisputed master brewer of this 'smoothly lethal concoction', whose main constituents were three parts concentrated frozen lime juice, two parts beer and one-part Everclear Light yellow/green in colour. Velvet Punch was mixed in a stainless-steel bowl liberated from the kitchen. For the benefit of visitors, a clean jock and a pair of athletic socks were added. The stainless steel 'tanker bowl' was refuelled throughout the night until there was no one left capable of restocking it.

At the south end of BOQ 310 (the Habu home away from home) was a kitchen where the crews had their pre-flight meal. Next to the kitchen was Doc Malley's room, where crews received their pre-flight physical exam. The Habus (under Buddy's leadership) convinced the Doc to give up his office for a crew lounge. They quickly set to work blanking out the entrance door and cutting an entry door into the now isolated room through the kitchen's broom closet. A proper bar, fancy light fixtures, music system and refrigerator were added, and the walls padded. The bright red decor of the 'Secret Bar' would have been more appropriate in a bathhouse. After the party room's reputation spread it became the envy of non-members, one of whom told the base commander, who would not tolerate Habu high jinks.

Intelligence gathering was, of course, OL-8's *raison d'être*, so it was not surprising that the Habus learned of the impending visit before the actual inspection. The Secret Bar was quickly and quietly dismantled one night, the old entrance was reopened and the room returned to its former state. When the base commander conducted his 'surprise' visit the next day, he was surprised he could not find what had been reported. Soon after the inspection, the room was again transformed into the Secret Bar and it was business as usual.

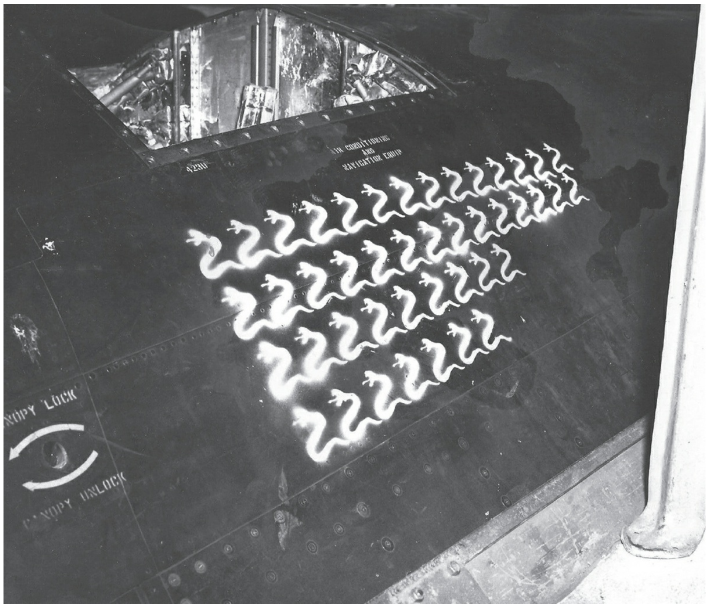
Partying with the Habus was great fun and in no time they were frequented (on John Storrie's leadership) by transiting airline crews who passed through Kadena on their way to and from Vietnam and Thailand, and by some of the unattached civilians who worked on base. One scatty blonde was given a meteorological nickname of 'High-Thin-Scattered', while another woman, with a narrow-shaped, longer-than-average face and nose was known as ‘Hangar Doors’, because the ‘giver of nicknames’ thought that she had been caught between them at some point in the past.

On the night of 29 May 1968, the Habus held a dinner at the Kadena Officers’ Club honouring Col Bill Hayes (the White Tornado), who had just completed his 30-day tour as OL commander and would return to Beale on the transpacific tanker in a few days. After dinner the party moved into the less formal Stag Bar, where Chief Master Sergeant Bill Gornick and two other senior NCOs crashed the party to say farewell to the colonel. Amid much hilarity, Bill Gornick produced a penknife and severed the neckties of Bill Hayes and all the Habu crew members. The next day he mounted the ties on a guide-on flagpole, just like the battle streamers on a command standard, or the feathers on a Native American ceremonial pole. A new tradition had been born.

In response, Don Walbrecht and Phil Loignon purchased a miniature Samurai sword and took it on a Mach 3.2 Hanoi flight before presenting it to Bill Gornick, the ‘Chief Master Necktie Cutter’. Thereafter, all crews flying their first operational mission from Kadena would wear a necktie inside their pressure suits. On completion of their sortie, they would emerge from the cockpit and have their tie ceremoniously cut off by Chief Gornick. Approximately 300 aircrew neckties, all properly embroidered with names and dates, and hanging from Bill Gornick’s ‘Command Standard’, which dates from 30 May 1968, were put on display at Beale’s Habu museum.

GLOWING HEAT

By the late summer of 1968, airframes ’974, ’976 and ’978 had each amassed close to 300 flying hours at Okinawa. In so doing, they had easily validated the concept of long-range, triple-sonic, high-altitude strategic reconnaissance within hostile airspace. Their sensor systems had acquired intelligence data of national significance that had directly influenced the conduct of many air and ground operations. The dedicated professionalism of the maintenance teams working for Col Estes, and the high-quality systems maintenance done by specialist company technical representatives, kept these deployed aircraft in top condition, but there were certain heavy depot-level maintenance tasks that lay beyond the capability of OL-8.



Habu operational mission tallies soon mounted, especially during the Vietnam War. (USAF)

For deep maintenance and tech-order modification work, the original three aircraft had to be returned to Lockheed’s Palmdale Plant 42. A complex every-other-day swap-out exercise codenamed Glowing Heat was executed in late September, with ’974, ’976 and ’978 being replaced by ’962, ’970 and ’980. These aircraft were similarly replaced in April 1969 by ’971, ’975 and ’979.

Newly promoted Lt Col Tony Bevacqua and his new RSO were participants in a Glowing Heat deployment from Beale to Kadena in ’974, in September 1969. They had just completed refuelling in the vicinity of Midway Island when one of the ‘generator-out’ lights illuminated on the telelight annunciator panel. It was a mandatory abort item, so they dumped much of the fuel load that had just been taken on and diverted into the tiny atoll.

Although Midway is a renowned breeding ground for the albatross, the population of these large birds had left the island a few days prior to Tony’s arrival, and he landed without incident (the birds often rested on the runway and were often hit by landing aircraft). Since Tony had led off the deployment, he was stuck on the island until the other Habus had been exchanged. A recovery team then came over from Kadena to solve their problem, as Tony explained:

> The place was all Navy. Our BOQ was a cement-block building with no air-conditioning and

> equipped with the world's most uncomfortable beds. To make matters less tolerable on this tiny island in the middle of nowhere, the 'O' club didn't open until 4:00pm and we had to sit it out there on 'the rock' for ten days while our friends were laying sonic booms on us as they shuttled their Habus back and forth across the Pacific. While there though, I had the pleasure of meeting Judy Sides, a nationally recognized and respected artist of the Gooney Bird [albatross].

By the time '974 was ready to complete its trip to Kadena, she had painted a Gooney Bird symbol on each wheel well door, applied another to each of the tails and another on the left side of the fuselage, near the cockpit where the white Habu-snake mission symbols were normally painted.

This short-lived artwork won the approval of the Habus at Kadena, and constituted a new kind of 'first' in aviation art.

Escalation of the Vietnam War generated an increase in the demand for timely, high-quality reconnaissance imagery. OL-8's SR-71 establishment was therefore increased in the spring of 1970 from three to four aircraft ('969, '972, '973 and '974). In many ways the next three years would prove to be the detachment's golden era.

MISSILES

On 20 September 1968, Maj Dale Shelton and Maj Larry Boggess completed their first operational sortie in aircraft '980. However, 30 minutes into their second operational flight on 4 October they were just approaching the KC-135 to top off after take-off when a coded message came through on HF radio from Sky King, SAC's Giant Talk network, telling them to abort their mission and return to Kadena.

'975's operational career began on 24 April 1969 when it was ferried to Kadena by Majors Buddy Brown and Mort Jarvis. (USAF via Tony Landis)

U.S. AIR FORCE
17969
2568

SR-71A '969 crashed in Thailand on 10 May 1970 near Korat RTAFB, following a subsonic high-speed stall. It's photographed on the ramp at Beale before deploying to Kadena. (USAF via Tony Landis)

Larry checked the authenticity of the message, but could not retransmit on HF since Dale had already started refuelling. Larry recalled, 'When we didn't answer immediately, we got a curt UHF radio call from the Kadena command post asking us if we'd received an earlier HF message transmission. We disconnected from the boom, dumped some fuel and recovered aircraft '970 back to Kadena.' It seems intelligence sources had discovered that the enemy knew of the Habu's intended route, which would take the jet directly over the top of an active SAM site. Although SR-71s had been fired upon on an earlier sortie, it was deemed the Vietnamese had too much of an opportunity on this occasion.

With a full-scale war raging in Southeast Asia, more and more crews had their chance to get a first TDY at Okinawa, which was proving a great place to fly the Habu from because it was far more secure than other bases in the region. Maj Bobby Campbell and Maj Jon Kraus flew their first sortie over Vietnam on 21 November 1968, a double-looper flown in '970 that lasted 5.5 hours.

Maj Bob Powell and Maj Bill Kendrick flew their first ops sortie in '980 on 29 December 1968 (again a double-looper lasting almost 6 hours), in which they were fired upon by two SA-2s. They brought back an especially high-quality take by flying straight through their target run despite rising missiles. They each earned a Distinguished Flying Cross for the mission. One Habu driver later remarked to the author:

> Flying an SR-71 over the war at eighty-odd thousand feet was almost unreal. The Thud drivers were right down there in the middle of things while we were passing high overhead safely out of reach of the Soviets' best weapons. On a clear day, you'd see (and hear) the war going on 15 miles below.
>
> We could sometimes see flashes of fighter aircraft charging about and could often hear the excited radio conversations on guard channel, especially if an aircraft was down. We were only at risk for 15 minutes on both passes because we could cross North Vietnam in less than eight minutes flat. We always knew, however, that we'd really be in for it if we ever had to bail out over enemy territory, for we would certainly have been a propaganda prize in our silver moon suits. We also had the advantage that in just a few hours we could be several thousand miles away back at the Secret Bar sipping a glass of Chivas Regal.

AIRCRAFT LOSS

Throughout the early 1970s, OL-8's Vietnam sortie rate averaged two flights per week. The nature of high-speed flight ensured that those combat sorties would never become ‘routine to the point of indifference’.

MARTINEZ/LAWSON

Majors Willie Lawson (right) and RSO Gil Martinez ejected safely from ’969. (USAF)

OL-8 lost its first Habu after more than two years of Kadena operations, which included more than 200 operational and training sorties. On 10 May 1970, Maj Willie Lawson and Maj Gil Martinez had completed one pass over North Vietnam and refuelled ’969 near Korat RTAFB. Willie had initiated an afterburner climb to prepare for a transonic dipsy-doodle. But thunderstorms had rapidly built up across Thailand; no matter where they looked, a solid bank of cloud enshrouded the heavy thunder cells, which towered up to 50,000ft.

Even an SR-71 needed climb distance to get above the clouds, and the dip manoeuvre gave the aircraft a head start on achieving the airspeed and Mach needed for a higher rate of climb. The 0.90 Mach preliminary climb was sluggish with a full fuel load, and Willie eased ’969 into a slightly steeper climb to zoom up over the notch of a 30,000ft saddleback of connecting clouds between vertical storms in order to stay clear of the cells ahead. At that moment, the aircraft entered turbulent clouds and both engines flamed out.

In severe turbulence, without engine thrust, the aircraft’s angle of attack increased. Suddenly the nose rose up into the dreaded pitch-up from which there was no recovery. Both crewmembers ejected safely and landed in the vicinity of U-Tapao. Resplendent in their silver moon suits, they recruited the aid of a Thai who was driving a *saamlor* (a three-wheeled vehicle common to Thailand) and were driven back to U-Tapao and then flown back to Kadena in a KC-135. On their arrival, Col Hal Confer (the Det commander) and the entire unit had gathered to welcome them. It was sad to lose a trusty Habu, but great to get the crew back. Overall, the pitch-up problem cost four aircraft in the 26 years of the SR-71 programme.

MORE IMPORTANT SORTIES

Flying time in the SR-71 (especially combat flying), was always considered a premium commodity among the 20 crews, who would wheel-and-deal with the staff schedulers for additional sorties. Although Southeast Asian sorties accounted for the majority of OL-8's flight hours, that area was not the exclusive domain of the Habu.

Majors Bob Spencer and Butch Sheffield were particularly pleased to be selected for a prize sortie on the night of 27 September 1971. After completing the ritual post-takeoff air refuelling in '980, they climbed away from the tankers on a northerly track opposite to the standard route south into Vietnam. US intelligence had obtained details of the largest ever Soviet naval exercise, to be held near Vladivostok, in the Sea of Japan. Undoubtedly, such an event could provide a rich source of intelligence data, and an SR-71 was the ideal vehicle with which to stir the Soviet fleet's defence systems into action.

17980
U.S. AIR FORCE

'980 began its second operational deployment following a 5.2hr ferry flight from Beale to Kadena by Majors Tom Pugh and Ronnie Rice on 19 June 1971. Note the Habu mission marks accumulating from its first deployment. (USAF via Tony Landis)

National security officials were especially interested in obtaining fresh data on the signal characteristics of the Soviets' new SA-5 SAM system, codenamed 'Gammon'. If details including its radar's frequency, modulation, PRF, pulse repetition interval (PRI) and other factors could be measured, it might be possible to develop an effective ECM device to reduce or even negate the SA-5's highly touted capabilities.

But there was a problem in that the various ELINT recorders carried on the SR-71 filtered the vast range of electromagnetic emissions transmitted from all sources and actuated special recorders when receiving only certain signal types – the continuous-wave signals, including those emitted by the SA-5, were not among them. Major Jack Clemence (an inventive electronic warfare officer), who worked in the 9th SRW's Electronic Data Processing (EDP) Center, jury-rigged one of the ELINT sensors by electronically cutting and splicing the pulse receiver's filtering system, which allowed it to receive a continuous-wave signal.

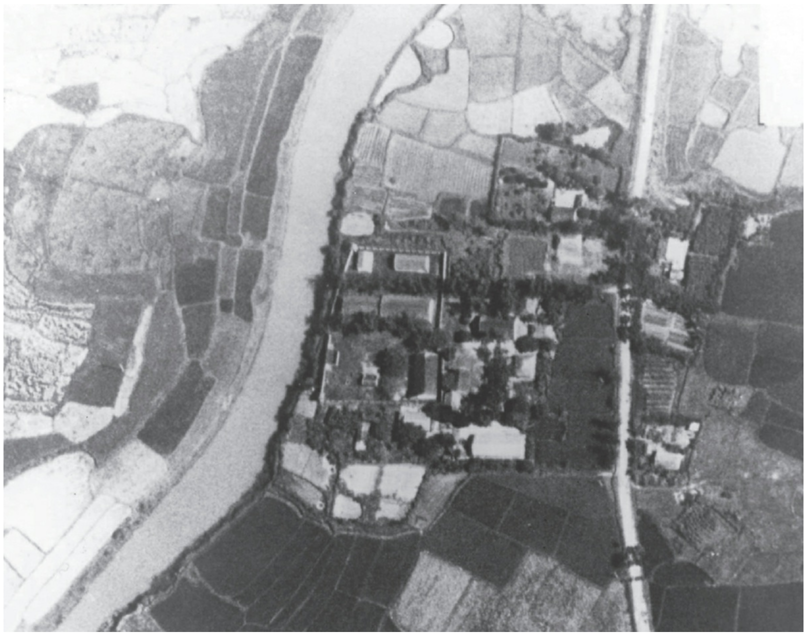
The possibility of night disorientation (caused by inlet unstarts and other hazards) over the dark northern Pacific led the mission planners to restrict most turns to a 25° bank limit while night flying at Mach 3.2. The two crewmembers of '980 concentrated their attention on the naval target area just off Vladivostok while slicing through the night in full afterburner. If they maintained their current inbound track toward the Soviet port and turned at a 25° bank, they would overfly the USSR, crossing high over the Khrebet Sikhote Alin, and exit the area into the Sea of Japan before returning to Kadena.

As they bore down on the target area, dozens of Soviet radars were switched on to record what appeared to be shaping up as a certain violation of sovereign Soviet airspace. The deception worked well, as '980 turned at the precise moment and failed to violate Siberian airspace having been programmed to roll into a full 35° bank instead of the previously recorded 25°, thus remaining international airspace. The SR-71 had never been flown at max Mach and turned at 35° of bank at night until this mission – the engine afterburners don't like large bank angles.

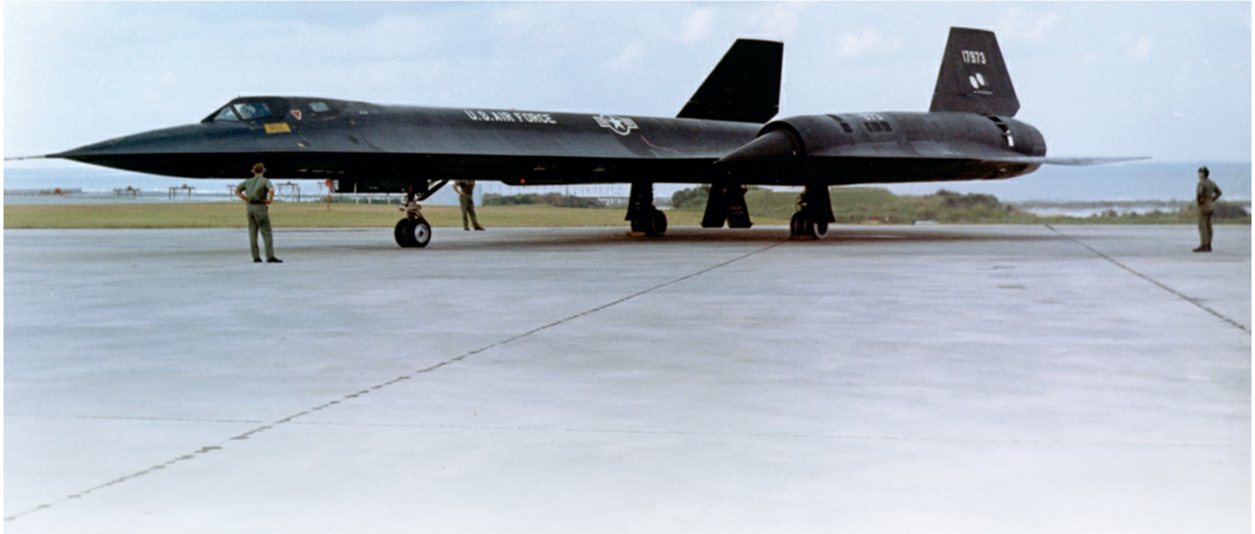
On their approach to the target area, Bob noted to his great dismay that the right engine's oil pressure was dropping. Nevertheless, he pressed on. They had completed their target run and were heading south towards home plate when he rechecked that critical oil pressure gauge. By then, its reading had fallen to 'zero', which was bad news indeed. After a brief consultation with Butch, he shut the engine down. Having already stirred up a hornet's nest of defence activity with their feinting pass over the Soviet Pacific Fleet, they were now forced to descend and continue the rest of their flight at subsonic speed, where they would be sitting ducks for any fast jets that might be scrambled to intercept the oil-starved Habu. To make matters worse, they encountered extreme headwinds that rapidly depleted their fuel supply. Butch calculated that a recovery back to Kadena was completely out of the question. Instead, they would divert into South Korea.

The OL commander had been monitoring '980's suddenly slowed progress and as the Habu neared Korea, US listening posts reported the launch of several MiGs from Pyongyang, North Korea, on what appeared to be an intercept attempt. USAF F-102 Delta Daggers were immediately launched from a base near Hon Chew, South Korea, and vectored into a position that put them between the MiGs and the SR-71.

Majors Bob Spencer (right) and his RSO Butch Sheffield secured an ELINT jackpot on the night of 27 September 1971, during a mission in '980 to monitor the Soviet Pacific Fleet off Vladivostok. (USAF)



Pre-raid imagery of the Son Tay POW camp. (USAF)



During the course of a 3.5-hour mission in ’973 on 21 November 1970, the day after Operation *Kingpin*, Majors Dave Fruehauf and Al Payne secured extremely good-quality imagery of the camp. Note the two dice on the tail. (USAF)

It was later established that the MiG launch had been unconnected with the Habu’s descent. Bob recovered ’980 into Taegu, South Korea, where the base commander had already received a call concerning his special visitor and was ready to receive the SR-71 and its crew. Their EMR take turned out to be ‘monumental’. In all, Bob and Butch had sniffed out emissions from 290 different radars. Of even greater significance to Western intelligence analysts were the ‘beautiful’ SA-5 signals they had captured – the first ever detected by Western observers.

Col Confer nominated the crew for the Silver Star, but it was turned down by the Air Force because the US wasn’t at war with Russia and the Silver Star can only be awarded for a combat mission during wartime (the Cold War did not count as a war).

Col Confer than put the crew forward for the Distinguished Flying Cross, but it was turned down because the Air Force said they could not find any data/or record of the flight (the NSA would have had the data but it appears that they would not give it to the Air Force). Butch Sheffield believed that Air Force Headquarters never knew about the mission.

MPC’S BLUE BOXES

On 5 April 1972, Lt Col Ed Payne (by then OL-8’s chief of intelligence) received a phone call from a friend at Norton AFB, California, who spoke in indirect references about ‘some blue boxes that would soon make Ed’s job easier’. The call was so obscure that he did not know what his Norton contact was trying to tell him until a week later, when he received a top secret message. The president had just signed the Defense Appropriation Bill, within which provision had been made for the OL to be equipped with a mobile processing centre that could perform post-mission processing at Okinawa rather than having to send the material to Japan or the US.

The computer portion of Mobile Processing Center I (MPC I), contained in eight 8×8×40ft ‘vans’ (similar to modern shipping containers), had been dispatched from Beale to Kadena in time for the arrival of the first three SR-71s deployed to the island in March 1968. Contained within these was the CDC-3200 computer equipment needed for SR-71 mission planning, programming the aircraft’s sensors and providing an initial scan of the SR-71’s ELINT collection. The remaining 15-van portion contained equipment necessary for processing the SR-71’s HRR and photo-reconnaissance collections and for preparing a detailed analysis of the aircraft’s ELINT collection – these were airlifted in by two Military Airlift Command (MAC) C-5 Galaxies. The AGT-30 Adage Graphics Terminal was shipped aboard a MAC C-141 StarLifter from Travis AFB.

Just before the arrival of Ed's Blue Boxes, an area at Kadena was rapidly prepared for them. The blue vans were quickly unloaded and moved to the newly prepared area, where they were interconnected to function as an in-theatre recce-tech unit. At 6:45pm on 18 April, Ed was on the phone to the NPIC informing them that he was ready for quick-response intelligence processing.

The OL could now process ELINT, COMINT and black-and-white imagery. With the MPC up and running, imagery was fast processed as soon as the Habu landed, and 'wet-read' by the photo interpreters who supplied an Initial Photographic Intelligence Report (IPIR) on the highest priority targets. Before the MPC was deployed, SAC flew the SR-71 film to the 548th RTG at Hickam AFB, Hawaii for processing and a preliminary readout, a process that took on average 40 hours. With the MPC in operation, this was cut to 11 hours.

This intelligence would be communicated in plain English on a secure telephone to appropriately cleared persons on Henry Kissinger's staff who could, if necessary, provide a report to the president within four hours of an SR-71 overflying key targets. Such direct reporting of hot intelligence was considered 'a remarkable achievement' for the time. Duplicate sets of negatives were immediately produced, with a set being flown to Eielson AFB, Alaska, where it was transferred to another courier aircraft and flown to Washington, DC to be sped onward to the NPIC. Another courier would deliver a set of negatives to the 12th RTS at Saigon for the next day's air strike planning. Other high-priority recipients were: (1) Fleet Intelligence, Pacific (FINPAC); (2) the 532nd RTS at Udorn RTAFB; (3) the 544th RTS at Offutt AFB, Nebraska; (4) SAC's B-52 force in Southeast Asia; (6) the DIA; (7) the JCS; and (8) the president and National Security Council.

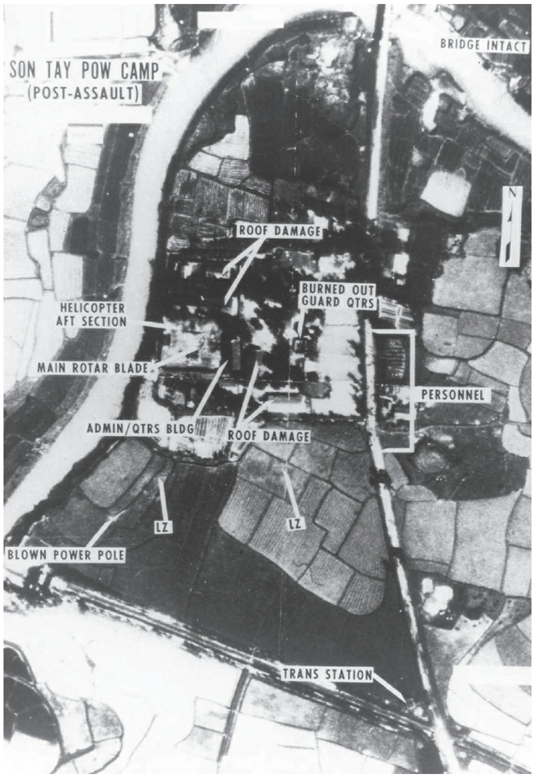
The MPC also accomplished an initial ELINT scan for high-threat signals within 3 hours after the SR-71 had returned. The complete Mission Intercept Report Electrical (MIRE) was produced in 20–24 hours, but final follow-on technical ELINT reporting was still conducted by the 9th RTS at Beale.

POWS

US aviators first became prisoners of war (POWs) of the North Vietnamese in 1964. History would later bestow upon several of them the dubious honour of being the longest-held US captives of any conflict to date.

The first US service members imprisoned during the Vietnam War were captured on 26 March 1964 near Quảng Trị, South Vietnam, when an L-19/O-1 Bird Dog observation plane flown by Captain Richard L. Whitesides and Captain Floyd James Thompson was brought down by small arms fire. They were followed on 18 July 1965 by Commander Jerry Denton who was shot down and captured by the North Vietnamese while flying an A-6A Intruder from USS *Independence*. Fiercely adhering to the six articles within the POWs' Code of Conduct, he was tortured for ten months, repeatedly beaten and forced to appear in a propaganda broadcast. Pretending to be blinded by the TV crew's spotlights, Denton began blinking, seemingly random spasms and tics. In fact, the brave pilot blinked out in Morse code 'T-O-R-T-U-R-E'. The film, made by a Japanese crew, was broadcast on American television on 17 May 1966, and was the first confirmation that US POWs were being subjected to atrocities. When the North Vietnamese realized what Denton had done, he was severely beaten in his cell for days.

On 9 September 1965, while flying A-4E 151134 off the deck of USS *Oriskany*, Cdr James Stockdale was shot down and imprisoned in Hoa Lo, Hanoi. Originally built by the French when Vietnam was one of its colonies, this notorious prison was renamed 'the Hanoi Hilton' by its US inmates. Stockdale was a senior POW and like Denton conformed rigidly to the Code of Conduct; he was singled out for regular beatings.


SON TAY POW CAMP
(POST-ASSAULT)
BRIDGE INTACT
N
ROOF DAMAGE
BURNED OUT GUARD QTRS
HELICOPTER AFT SECTION
MAIN ROTAR BLADE
PERSONNEL
ADMIN/QTRS BLDG
ROOF DAMAGE
LZ
LZ
BLOWN POWER POLE
TRANS STATION

Post-strike reconnaissance image of the POW camp at Son Tay, taken by an SR-71's OBC camera. (USAF)

Notwithstanding, he played a key role in establishing a highly effective covert system of inter-prisoner communication, even when individuals were placed in solitary confinement, and became head of the prisoner escape committee at Hoa Lo. He used 'double-speak' in letters home to his wife and she realized he was sending her coded information about the POW camp and its conditions, and took the letters to Cdr Donn T. Burrows at the Office of Naval Intelligence (ONI). She bravely agreed to play a vital role in establishing a covert two-way communications link via the couple's letters. This delivered important information about the condition of Hoa Lo's inmates and other intelligence to the ONI, and enabled it to get information back to Stockdale.

When Capt John Dramesi and Capt Edwin Atterberry managed to escape from the Zoo Annex, a POW camp near Hanoi, on 10 May 1969, only to be recaptured 12 hours later some three miles away, the repercussions for all the POWs were extreme. Convinced that others must have been involved in supporting the breakout, the prison authorities unleashed an orgy of unbridled sadistic cruelty. The two escapees were tortured and beaten for 38 days, Atterberry dying as a result. The beatings were then extended to many of the POWs incarcerated in a dozen facilities throughout North Vietnam. As a result, captured senior officers implemented a slight revision to the Code of Conduct, whereby further escape attempts wouldn't be sanctioned unless external help was available, thereby ensuring a greater chance of success.

On 10 June 1970, a feasibility study group was convened by the Special Assistant for Counterinsurgency and Special Activities (SACSA), codenamed Polar Circle, to look into the possibility of springing the 61 POWs believed to be at the Son Tay camp, located about 23 miles West of Hanoi. A training, planning and development group codenamed Ivory Coast was established on 8 August to review reconnaissance imagery provided by Teledyne-Ryan Buffalo Hunter reconnaissance drones and SR-71s. The low-flying drones were used sparingly over the target area for fear of alerting the North Vietnamese to the possibility of a raid. However, flying at extreme altitude and using its Tech or panoramic cameras, the SR-71 was an ideal platform for obtaining high-resolution photos of the camp without drawing unwanted attention.

In the last ten days before the planned raid, intense reconnaissance efforts were conducted, but every attempt was thwarted by poor weather. Continuous cloud cover concealed Son Tay from the Habu's high-altitude cameras, and two drones never returned. Nevertheless, Operation *Kingpin,* the bold raid to rescue the POWs, was mounted in the morning darkness of 21 November 1970. It employed 56 US special forces troops, deployed in five HH-53 Super Jolly Green Giant helicopters, and included 23 other direct support aircraft.

However, after an eight-minute firefight in which between 50–100 North Vietnamese Army guards were killed, it was discovered that the inmates had been moved to another camp (Dong Hoi, 15 miles further east) a few days prior to the raid. Various reasons for the move have been given, including contamination of the camp's well due to flooding and the beginning of a major relocation of all POWs from outlying camps to those located in and around Hanoi.

There's little doubt that the lack of detailed, timely photo-intelligence was a key contribution to *Kingpin* failing to achieve its primary objective, as was excessive compartmentalization, which denied the planners access to a 'bigger intelligence picture'. However, most returning POWs after the war reported that as a result of the Son Tay raid, their treatment and conditions improved.

By 1972, it had been reported that covert communication into Hoa Lo had become possible by the limited use of a radio, infiltrated into the prison by the CIA. A plan formulated by Capt John Dramesi to escape with a fellow POW between 1 and 15 June, steal a boat and travel down the Red River to the Gulf of Tonkin, where they could be rescued by a team of US special forces was communicated to the camp's senior ranking officer (SRO). Once approved, it was communicated to the ONI and then escalated to the very top of the chain of command – the commander-in-chief, President Richard Nixon, who also approved the audacious plan.

Following a double generator failure Majors Tom Pugh (right) and RSO Ronnie Rice were forced to overfly Hanoi in '978 at just 41,000ft on 15 May 1972. They got away with it and diverted into Udorn RTAFB. (USAF)

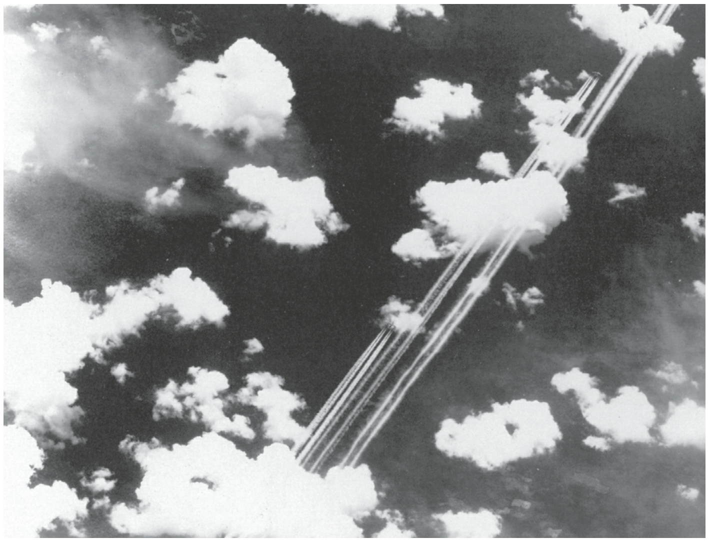
In April 1972, the submarine USS *Grayback* (LPSS 574), under the command of Cdr John Chamberlain, slipped its moorings at Subic Bay, Philippines and put to sea. On board was US Navy SEAL Team One and Underwater Demolition Team 11 (UDT-11). The plan, Operation *Thunderhead*, developed by Lt Cdr Edwin Towers, the officer in charge (OIC), involved the SEAL team infiltrating an island in the Red River estuary using underwater swimmer delivery vehicles (SDVs). From there they'd provide surveillance, which would be enhanced by up to four flights per day of a wider area conducted by HH-3As from Detachment 110, Helicopter Support Squadron (HC-7), from USS *Midway*. To cover Dramesi's escape plan, the operation was to be run from 29 May to 19 June.

To ensure that the POWs directly involved in Operation *Thunderhead* were fully aware of the CinC's approval of the plan, a unique covert signal was devised – two tri-sonic booms, exactly 15 seconds apart, would ring out over Hanoi on 2 and 4 May. To generate this 'sound of freedom', the services of two SR-71s would be required. However, since the mission was so critical, a third airborne spare would also be launched as a hedge against any last-minute mechanical problems that might interfere with the signal's timing.

At precisely 2:16pm on 2 May 1972, Maj Bob Spencer and Maj Butch Sheffield were airborne in '979, followed just two minutes later by Lt Col Darryl Cobb and Maj Reggie Blackwell in '980. At 3:22pm Maj Dave Fruehauf and Maj Gil Martinez launched in '968. The missions recovered back into Kadena with '979 having logged 4.8 hours, '980 clocking up 3.8 and '968 clocking 4.1.

On 4 May, Majs Tom Pugh and Ronnie Rice approached Hanoi in aircraft '968 at 75,000ft from the south, while Majs Bob Spencer and Butch Sheffield maintained 80,000ft in '980 and flew across the target from the south-east. Meanwhile Lt Col Darrel Cobb and Maj Reggie Blackwell were the airborne spare in '978; they were to cross the 'Hilton' at 70,000ft from the west should either of the primary aircraft have to abort. When the pre-arranged code word was transmitted, Darryl broke off his run short of the target area.

Both missions were termed 'entirely successful' and accomplished their objective within the very tight time constraints, while reconnaissance gathering was of secondary importance to the signal. Unknown to the planners on the 'outside', however, there was a major issue with the SRO in Dramesi's room, who'd become aware of the plan. Despite the escape committee having determined that the plan had a 90 per cent chance of success, he'd gone to the camp SRO and reminded him of the repercussions felt by the rest of the POWs after Dramesi's and Atterberry's earlier escape attempt. The appeal caused the camp SRO to reverse his earlier decision. He withdrew permission to conduct the escape and ordered the escape committee to stand down. Since there weren't the means to communicate this decision quickly enough, Operation *Thunderhead* was launched regardless. It was eventually called off after a number of mishaps, one of which resulted in the death of Navy SEAL Lt Melvin Spencer Dry.



This cell of three B-52s – in standard combat formation for the type – was photographed by an SR-71A's TROC as the cell crossed into North Vietnam some 50,000ft below the Habu. (USAF)

LT/COL POWELL
COLEMAN
NO STEP
NO SEAT

Lt Col Darrell Cobb (right) and RSO Capt Reggie Blackwell completed the only operational night Habu mission of the entire Vietnam War, on 27/28 December 1972 in '975. They received Air Medals for the sortie. (USAF)

17978
978
U.S. AIR FORCE
USAF

Widely known as the 'Rapid Rabbit', '978 was ferried into Kadena for its third deployment on 16 June 1971 by Majors Ben Bowles and Jimmy Fagg. (USAF via Tony Landis)

A CLOSE CALL

On 15 May 1972, Maj Tom Pugh and Maj Ronnie Rice were airborne in '978 on Tom's 236th SR-71 sortie. They were flying a routine Giant Scale mission, scheduled to be a double looper up through the Gulf of Tonkin for a front door entry. Just short of Haiphong, Tom's concern over a strange cyclical hum in the interphone system was relieved when the generator bus tie circuit split, allowing independent operation of each of the 60 KVA AC generators, one of which had been responsible for the varying frequency, hence the hum. Freed of the AC bus load sharing, the system seemingly returned to normal. The Go-No-Go checklist allowed the mission to proceed. While Tom was maintaining Mach 3.18 at 79,500ft, a generator failed. That failure was a mandatory abort item, so the crew began making provisions to divert into Thailand.

Just over a minute later the other generator failed, and they were in real trouble. Emergency AC and DC power did not come online and the fuel boost pumps stopped pumping JP-7 to the engines. Without electrical power, the SAS cut out, and lacking boost pump pressure the fuel flow to both engines stopped, causing them to flame out. To add to the crew's grief, the inlet spikes went full forward and, as ’978 began pitching and rolling rapidly, Tom knew the aircraft was approaching the limits of its supersonic flight envelope. Tom instructed Ron to ‘get ready to bail…’, but the intercom system failed before he could finish the statement. He held the stick gently while struggling to control the jet (without causing further pilot-induced oscillations), and while also trying to reach the all-important ‘standby electrical switch’ located on his right-hand panel. To reach that critical switch, he had to move his left hand off the throttles and on to the control stick in order to free his right hand so he could restore some electrical power to the aeroplane. This accomplished, Tom initiated a gentle ‘needle ball and airspeed’ turn towards a ‘friendly piece of concrete’. Having descended to 41,000ft and slowed to just Mach 1.1, he managed to get one generator back online and both engines relit. He then reaccelerated ’978 to Mach 1.7 to exit the area as quickly as possible. Tom crossed Laos to recover ’978 into Udorn RTAFB without further problems.

Although all unconnected with its ultimate demise, ‘978 had to be diverted on four occasions during its third deployment, the final occasion being on 15 July 1972. It crashed and was written off following a landing accident at Kadena five days later. (USAF via Tony Landis)

The serious nature of the malfunction necessitated a subsonic return to Kadena even after repairs had been made. As they set off with two tankers (one carrying the recovery team), they heard another SR-71 diverting into U-Tapao RTAFB. The tanker with the maintenance team peeled away from ’978 and headed back to Thailand to recover the other aircraft. At their post-flight analysis, Tom and Ron learned that they had overflown Hanoi at 41,000ft.

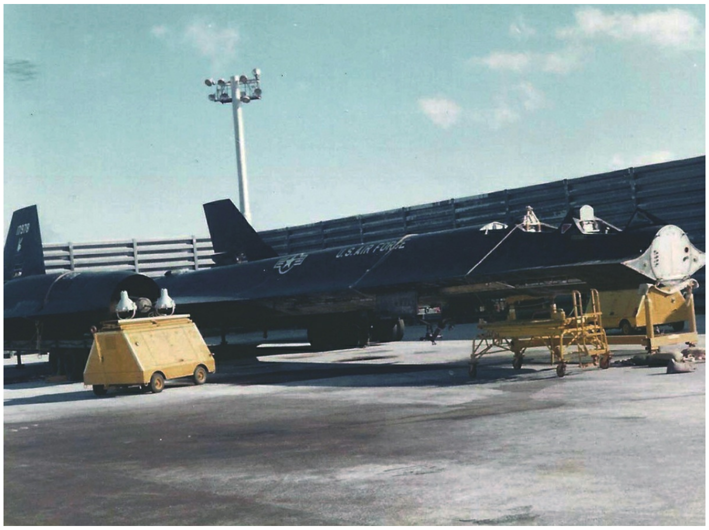
They had been extremely lucky, considering the number of SAMs that encircled the city. It appeared that the Vietnamese radar operators and their Soviet advisers had been ‘asleep at the switch’ during ’978’s mid-altitude pass over one of the best-defended cities in the world. The ‘Bunny’ had pulled off a lucky escape from what appeared to be an easy shootdown situation. Two days later, ’978 had been repaired and the two intrepid aviators returned the aircraft to Kadena. Tom and Ron were each awarded Air Medals for meritorious achievement in ‘the successful landing of their disabled aircraft’.

On 30 May, ’978 was at the centre of yet another scary episode. Maj Bob Powell and Maj Gary Coleman were approaching Hanoi in a front door entry when the SAS failed. They had just entered a 30° bank at Mach 3.2 and 81,000ft when the aircraft started porpoising. As Bob struggled to master the destabilized flight characteristics, he found that he had to decelerate and descend to where the aircraft would be more manageable. Gary radioed the tanker with a delayed rendezvous time because they would be approaching at subsonic speed. Bob completed a somewhat ragged aerial refuelling and trailed a spare tanker to the east coast of Vietnam, where they filled the tanks and slogged their way back to Kadena at 0.9 Mach (logging 6.5 flying hours).

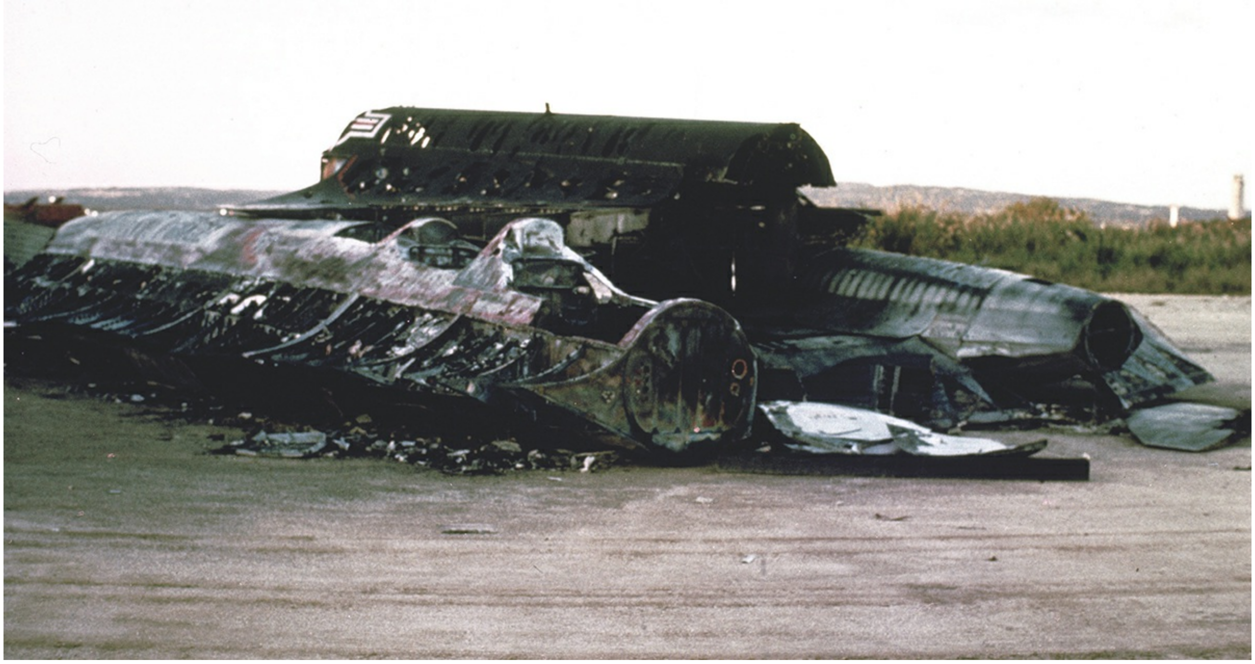
FAREWELL TO THE ‘BUNNY’

On 20 July 1972 the ‘Rapid Rabbit’s’ luck finally ran out. While returning from an operational mission, Maj Denny Bush and Maj Jimmy Fagg approached Kadena to learn of excessive crosswind landing conditions. On touchdown, Denny deployed the aeroplane’s large braking parachute in a rapid deploy jettison technique to prevent ’978 from weathercocking sharply into the wind and running off the side of the runway.

Unhappy with the first touchdown, he jettisoned the ’chute, pushed up the power, and ‘took it around’ for another landing approach. Although he successfully touched down on the second attempt, the crosswind was so strong that he was unable to keep the weathercocked aircraft on the runway. During the off-runway landing rollout, one set of main wheels struck a low concrete structure, severely damaging the landing gear and causing substantial additional damage to the aeroplane. Both crewmembers clambered out unscathed, but ’978 was written off. The aircraft was dismantled and transported back to Norton AFB via Yokota AB in C-5 Galaxy 69-0007 and used as spare parts for the other SR-71s.



’978 is seen here stripped of engines, ejection seats and avionics. (Via Tony Landis)



An attempt was made to burn ‘978’s wreckage. Needless to say, the fire was unable to reach the necessary temperatures to destroy titanium, so it was airlifted to Norton AFB in a C-5 Galaxy. (USAF via Tony Landis)

HABU SUPPORT OF B-52S

The flexible response strategy adopted by the Johnson administration to fight the Vietnam War caused SAC to examine the tactical potential of its strategic bombers in the conflict. By mounting multiple-ejector racks on the wing missile pylons of certain B-52Fs, a further 24 bombs could supplement the 27 bombs that could already be hauled internally, almost doubling the bomb load.

As the situation in South Vietnam worsened, the JCS decided to deploy the modified B-52Fs to Andersen AFB, Guam, in February 1965. Under the code name Arc Light, the aircraft could be used to strike targets in North Vietnam in reprisal for terrorist action against US personnel in the south. Soon after an ineffectual bombing raid by a large number of fighter-bombers against Viet Cong base camps near Black Virgin Mountain on 15 April 1965, General Westmoreland obtained permission from Secretary of Defense McNamara to use B-52s in support of tactical operations in South Vietnam.

The first big strike took place on 18 June 1965, when 30 B-52s flew a 12-hour/5,500-mile round trip from Guam to the Ben Cat Special Zone in Binh Duong Province northeast of Saigon. As these Arc Light sorties continued, a modification programme known as Big Belly got under way back in the US. Between December 1965 and September 1967, 82 B-52Ds received new radar transponders for ground-directed bombing, and bomb bay and pylon modifications that increased their carrying capacity to a staggering 108 bombs weighing 81,000lb.

On 1 April 1966, the 28th and 454th Bombardment Wings deployed to Guam and began flying regular Arc Light sorties. In addition to the great increase in firepower that these Big Belly bombers represented, the sortie rate was increased from 450 to 600 flights per month. Seven Combat Skyspot radar-directed bombing ground sites were established, the first coming on line at Bien Hoa in March 1966. These sites, working in conjunction with the B-52s' new radar transponders, helped to improve bombing accuracy.

On 11 and 27 April 1966, B-52s struck North Vietnam for the first time, hitting targets in the Mu Gia Pass, which was the keystone of the notorious Ho Chi Minh Trail's supply network. The B-52 sortie rate increased as the ground war continued to deteriorate, and by February it had reached 800 flights per month. Meanwhile, Guam had reached its saturation point in regards to the number of B-52s that it could support. Thereafter, additional aircraft were deployed to U-Tapao RTAFB at Sattahip, Thailand.

A year later McNamara approved yet another increase to 1,200 and then finally 1,800 B-52 sorties per month. On 1 November 1968, President Johnson called a halt to *Rolling Thunder* bombing against North Vietnam. Target emphasis for the B-52s changed to Commando Hunt operations in an effort to stem the tide of men, equipment and fuel being infiltrated into South Vietnam via a supply network in Laos. Eight months after the election of President Nixon, Secretary of Defense Melvin Laird cut the B-52 sortie rate to 1,400 per month. Two years later, the monthly rate was further reduced to 1,000 sorties and many aircraft and crews were returned to the US.

In early 1972, however, an enemy build-up along the Laotian trail network indicated the prospects of an imminent offensive. Gen Creighton Abrams and Adm John McCain (CINCPAC) requested additional Arc Light sorties to forestall this rising threat. On 8 February the JCS authorized 1,200 monthly sorties and ordered 29 more B-52s to Guam. In a major invasion effort on 30 March 1972, the enemy hit South Vietnamese positions in Quang To, Kontum Pleiku and Binh Long provinces. As a result, President Nixon ordered a resumption of the bombing of North Vietnam, a policy that had been in abeyance since 1 November 1968. As the situation worsened on all three fronts, B-52Gs were deployed for the first time. They brought the bomber force to 133 aircraft, which could fly as many as 2,250 sorties per month.

In an operation codenamed Linebacker, five B-52 strikes were launched, the first on 9 April against petroleum storage facilities and the railyard at Vinh. This was followed by a raid codenamed Freedom Dawn on 12 April that hit Bai Thuong airfield; four days later, Freedom Porch Bravo targeted petroleum, oil and lubricant facilities around Haiphong. Then, on 21 April, Freighter Captain launched strikes against Hamn Rong, the trans-shipment point and the Thanh warehouse area. Two days later, Frequent Winner re-visited the same target list as that hit on 21April. Linebacker marked the first time that B-52s had ventured into the heavily defended Hanoi-Haiphong area, and they came away unscathed.

SAC was requested to increase the number of SR-71 reconnaissance sorties to obtain imagery for bomb-damage assessment. On 8 May, as the war escalated, President Nixon ordered that passages into and out of North Vietnam harbours should be mined. The next day, in an operation codenamed Pocket Money, the JCS directed that drones and the SR-71 should photograph, on a daily basis, the ports of Haiphong, Hon Gai, Gam Pha, Dong Hoi, Quang Khe, Vinh and Thanh Hoa, to identify the enemy's shipping channels in readiness for US Navy aerial mining operations.

One week into the operation, the JCS designated the SR-71's HRR as an acceptable sensor for this purpose. This was the first occasion that the JCS had specifically directed that the HRR should cover a predetermined intelligence target and, by so doing, it signalled that the technology had officially come of age.

In June, the JCS required the SR-71 to photograph communication and logistics supply lines between North Vietnam ports and Chinese border areas. Throughout this time the SR-71 also used its sophisticated electromagnetic reconnaissance system to collect ELINT, as part of SAC's Combat Apple SIGINT collection operation in Southeast Asia, which also used U-2 and RC-135 platforms. As the situation on the ground continued to deteriorate, additional B-52s were deployed to the region and by late June, 200 of the giant eight-engined bombers had been deployed to the region and were chalking up in excess of 3,100 sorties per month; they were having a decisive effect on the North's invasion.

Having got airborne from Kadena at 13.30hrs on 6 February 1971, Majors Tom Estes and Dewain Vick were forced to air abort in '972 due to a mechanical malfunction and divert into Kunsan AB South Korea – as seen here. (USAF via Tony Landis)

On 21 April 1972, AFLC, in conjunction with the SR-71's Advanced Systems Program Office, began flight-testing the prototype Capability Reconnaissance Radar (CAPRE). It promised a significant increase in resolution over the Goodyear GA-531 installation then operational on the SR-71 fleet. The 12 evaluation flights conducted within the United States on the radar prototype were successfully completed by AFLC on 15 July 1972, and on 11 August Maj Bob Powell and Maj Gary Coleman flew aircraft '975 to Kadena as part of the autumn Glowing Heat aircraft rotation; on board was the new radar, deployed for the first time to undertake its operational evaluation.

The first of these sorties was launched at 3:45pm the very next day, the crew consisting of Bob Cunningham and his RSO George 'GT' Morgan. By November the new system had demonstrated capabilities that far exceeded those of the PIP radar.

Five more CAPRE units had been contracted by SAC and plans called for the final unit to be delivered by May 1973. However, the production radars experienced a 23 per cent failure rate during AFLC certification, many of the problems being attributed to the failure of a heat-resistant epoxy that caused the radar's antennas to malfunction. Before the production units could be deployed to Kadena, SAC insisted that ten successful flights from Beale must be accomplished. As a result, the first CAPRE production unit wasn't delivered to Beale until 5 June 1973, missing the June Glowing Heat aircraft rotation. SAC HQ therefore directed that the prototype CAPRE unit be retained at Kadena until the production models became available for operational use.

In late October 1972, President Nixon called a halt to bombing north of the 20th parallel in anticipation of a truce. As a hedge against peace talks becoming deadlocked or breaking up, he also ordered the JCS to plan new strikes against the North that would concentrate on the Hanoi-Haiphong areas. On 13 December 1972, the North Vietnamese delegation walked out of the Paris peace talks (throughout the long period of negotiations, North Vietnam had used the time to rebuild and strengthen its badly damaged positions). Two days later, Nixon ordered the execution of Linebacker II. Initially planned as a three-day B-52 maximum night effort, this major operation extended through 11 days of heavy bombing. The primary aim was to cut off the supply of equipment and supplies at their source and strangle the North's war effort.

On Day One (18 December), 121 B-52 sorties were flown. Two chaff corridors were sown by F-4s, but 100kt winds blew the protective curtain away before the B-52s arrived. Charcoal 1, a B-52G leading nine other Guam-based aircraft against the Yen Vien/Ai Mo warehouse area, was hit by two SA-2s and became the first B-52 lost to hostile action in the war. Two other bombers were shot down by some of the 200 SAMs launched that night.

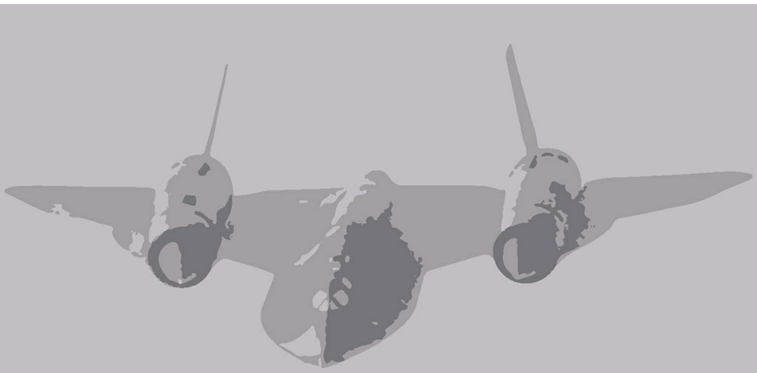
On Day Two of the campaign, 93 B-52s hit targets that included the Radio Hanoi broadcasting station, Kinh No, Yen Vien, Bac Giang and Thai Nguyen. Another 200 SA-2s were fired, but no aircraft were lost; however, on the night of 20 December, six B-52s fell to SAMs. By Christmas Eve (Day Seven of the campaign), 11 B-52s had been shot down. After a 36-hour pause over

Christmas, operations resumed. Using revised tactics, 113 aircraft battered ten different targets in seven 15-minute waves. Two more B-52s were knocked down by SA-2s despite the fact that more than 100 fighter-bombers had suppressed SAM batteries in the Haiphong area.

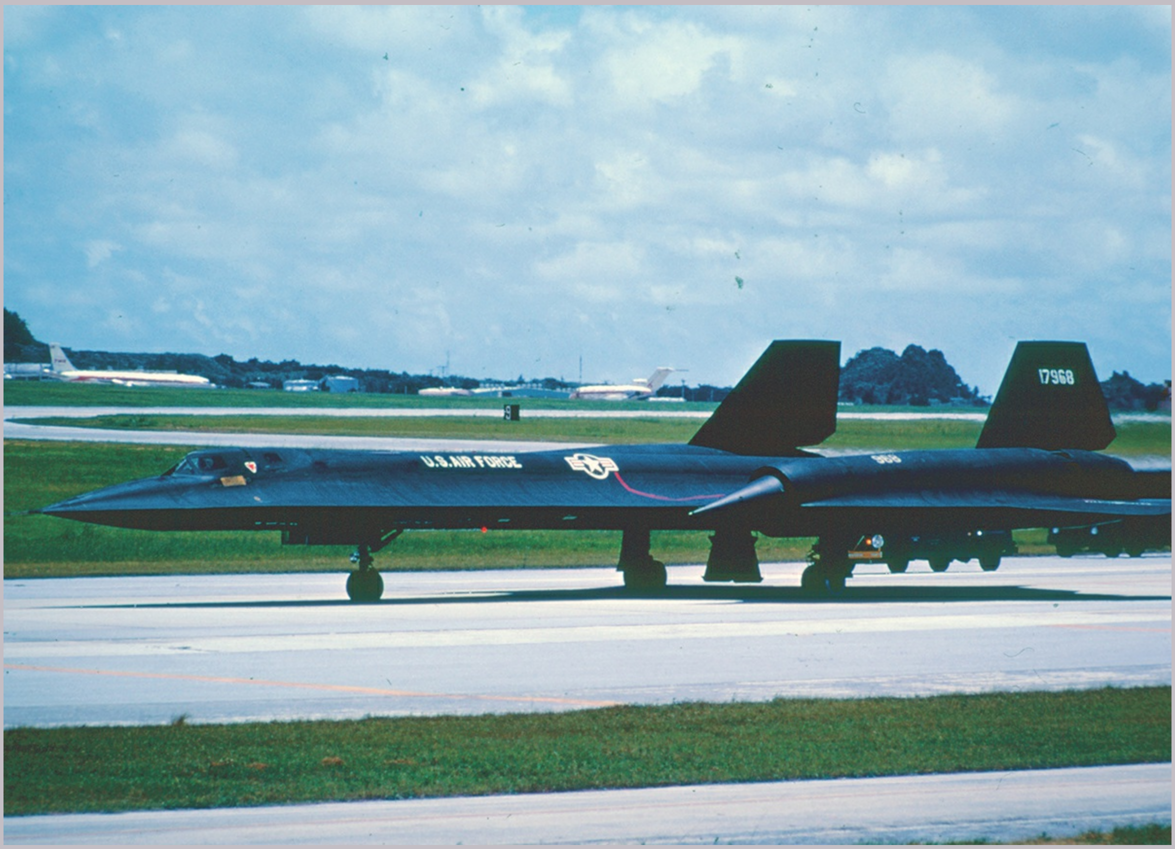
An hour before midnight on 27 December 1972, Giant Scale mission GS663 got under way when SR-71 '975 lifted off Kadena's runway on what would prove to be the only Habu night sortie of the entire Vietnam War. Col Darrell Cobb and RSO Capt Reggie Blackwell's mission objective was to conduct a coordinated EMR/HRR sortie to determine if the North Vietnamese had acquired new equipment or employed updated procedures for the SA-2s that were responsible for generating such high B-52 losses. To achieve this, their arrival over the Haiphong/Hanoi areas was timed at precisely the same moment that 60 B-52s were to begin dropping their bombs on the railyards at Lang Dang, Duc Noi and Trung Quant, the Van Dien supply centre and three missile sites. With the North's defensive radar systems running at full stretch to cope with the raid, intelligence planners reasoned that this would be an ideal time for such a sortie. In addition, the SR-71, with its unmatched ECM suite, would provide additional electronic support for the bombers.

As they arrived over the collection area on schedule, Cobb and Blackwell observed numerous SA-2 firings. During the fleeting moments when they were crossing the immediate target area, they were able to radiate a blinding ECM blanket from their DEF system. During the course of the raid, only one Guam-based B-52 was lost. Darrell and Reggie landed back at Kadena at 0239 hours. The next day they learned that their mission had produced a wealth of intelligence data.

The two 60-bomber raids launched on the final two nights of Linebacker II saw all B-52s arrive back at their bases safely. Following the action on the night of 29/30 December, the North Vietnamese government expressed a willingness to return to the negotiating table. The B-52s had flown a total of 729 sorties during the 11 days of Linebacker II operations (340 from U-Tapao and 389 from Guam). Thirty-four separate target areas had been hit as the B-52s dropped about 15,000 tons of bombs. The North Vietnamese had fired hundreds of SA-2s, destroying 15 of the bombers (nine B-52Ds and six B-52Gs) and damaging nine others. The stunning onslaught that the North had received from Linebacker II drove the North Vietnamese negotiators back to the Paris peace talks.



CHAPTER 14:
DET 1 OPERATIONS POST THE VIETNAM WAR



Having been one of the jets to have boomed the 'Hanoi Hilton' in May 1972, '968 was redeployed back for another operational spell 12 June 1973. This time the aircraft was in theatre for 14 months, and was flown back to Beale on 14 August 1974 by Majors Bob Helt and Larry Elliott. (Lindsey Peacock)

MONITORING THE PEACE AGREEMENT

The JCS directed that CINCPAC temporarily suspend all offensive operations against North Vietnam with effect from 15:00Z on 15 January 1973. Reconnaissance operations were restricted to satellites and SR-71 missions. The conflict in Vietnam ended for the United States when the Paris Agreement came into effect at 23:59Z on 27 January 1973, which committed the withdrawal of US forces from South Vietnam. The agreement included: (1) the release of US prisoners of war within 60 days; (2) the formation of a Four Party Joint Military Mission; (3) the establishment of an International Commission of Control and Supervision; (4) the clearance of mines from North Vietnamese waters; and (5) free elections for all Vietnamese. In addition, the JCS prohibited 'all reconnaissance over North Vietnam and its claimed territorial waters.'

Following the ceasefire, OLKA continued to gather bomb damage assessment imagery of B-52 strikes in Cambodia in addition to the status of various North Vietnamese-occupied airfields; these included Tchepone in Laos, and Cam Lu and Kham Doc in South Vietnam. The Plaines De Jarres in Laos also received regular visits from the SR-71, in order to monitor the infiltration of men and materiel moving from North to South Vietnam.

17972
U.S. AIR FORCE

When Majors Jay Murphy and John Billingsley touched down at OL-8 in '972 on 15 July 1976, it marked the beginning of the aircraft's third operational deployment. (USAF via Tony Landis)

On 17 February 1973, Carroll ‘Bud’ Gunther and Tom Allocca departed Kadena at 1:00pm on mission GS-696, a four-hour operational sortie in aircraft ’975. Of particular interest on this mission was the area around Khe Sanh airfield; the intelligence community was extremely pleased by the take once it had been processed. It revealed that adjacent to the airfield, AAA emplacements had been built and a new, unnumbered supply route and truck park was also discovered, together with a probable cave storage area and two operational SA-2 sites – the first to be discovered in this area since the late spring of 1972. Such a high level of activity led the analysts to conclude that the occupying Communists intended to make Khe Sanh a permanent control point for operations in the south of the country.

To comply with the terms of the Vietnam ceasefire prohibiting US reconnaissance aircraft overflight, the SRC devised a route for the SR-71 that involved six 45° bank-angle turns, enabling the aircraft’s camera and SLAR systems to obtain imagery from well inside North Vietnam during peripheral missions. To ensure that the Communist North was adhering to the terms of the Paris accords, the JCS directed that two SR-71 sorties were to be conducted in April.

The first of these, GS-722 was flown by Maj Harold ‘Buck’ Adams and Maj Bill Machorek in aircraft ’971 on 19 April 1973. Owing to heavy cloud cover, the intelligence obtained during the sortie was almost entirely generated by the CAPRE high-resolution radar. It proved that the Viet Tri rail and road bridge, located 30 miles northwest of Hanoi, had been interdicted since imagery had been collected by Bob Cunningham and Jimmy Fagg in ’975 during their 23 January mission. Photography collected during that earlier sortie had also caught 11 MiG-21s parked on the western alert apron at Phuc Yen airfield. However, analysis of the HRR imagery obtained on the 19 April sortie suggested that no aircraft were then on alert.

Photo interpreters noted that a similar situation had prevailed at Phuc Yen during Linebacker II, when the MiGs had been moved off the base’s apron areas and into cave storage facilities; after the bombing halt and the signing of the peace accords, the MiGs were once again parked on the alert aprons. Intelligence specialists therefore concluded that the absence of interceptor aircraft at Phuc Yen on 19 April was consistent with an increase in alerted air defence posture.

Clearing skies enabled a conventional camera configuration to be carried on the second monitoring sortie; this would enable analysts to crosscheck the HRR imagery obtained five days earlier. Giant Scale flight GS-725 got under way on 24 April 1973 when Maj Pat Bledsoe and Maj Reggie Blackwell left Kadena at 11:45am in aircraft '963. Additional targets covered by this 5.5-hour flight were the Ben Thuy trans-shipment point, and the petroleum products storage facilities at Vinh and Bai Thuong airfield. Yet again the SR-71 proved its worth. At Bai Thuong airfield, located 77 miles southwest of Hanoi, '963's cameras detected large amounts of materiel, equipment and vehicles, and evidence that bomb craters on the main runway and parallel taxiway had been repaired. Three coastal petroleum barges were noted in the vicinity of the Vinh bunkering pier and a moderate amount of activity was also recorded at the Ben Thuy trans-shipment point, located about four miles east of Vinh.

ANOTHER SA-2 ATTACK

On 27 May 1973, Maj Bob Cunningham and his RSO Maj Jimmy Fagg were airborne from Kadena in '963. Their mission was to continue surveillance of North Vietnamese activities and monitor compliance to the peace agreement. Whilst in the vicinity of Khe Sanh airfield, they were fired upon by an SA-2. The CIA's 28 May President's Daily Brief noted that, 'the SA-2 unit at Khe Sanh fired at an SR-71 reconnaissance aircraft on May 27 but missed. This was the first known firing by the SAM unit since it moved into South Vietnam just prior to the cease-fire last January.'

Parallel with the activity detailed above, within two weeks of the Vietnam ceasefire the Pacific Command ELINT Center requested SAC to provide increased electronic reconnaissance of various signal threats emanating from Laos. On 9 February 1973, SAC requested the SRC to schedule two SR-71 ELINT missions per week against Laotian objectives throughout the remainder of the year. Despite this additional tasking, the overall level of activity at the Det had decreased. The result of which was that from 13 June 1973, the number of Kadena-based SR-71s was reduced from four to three.

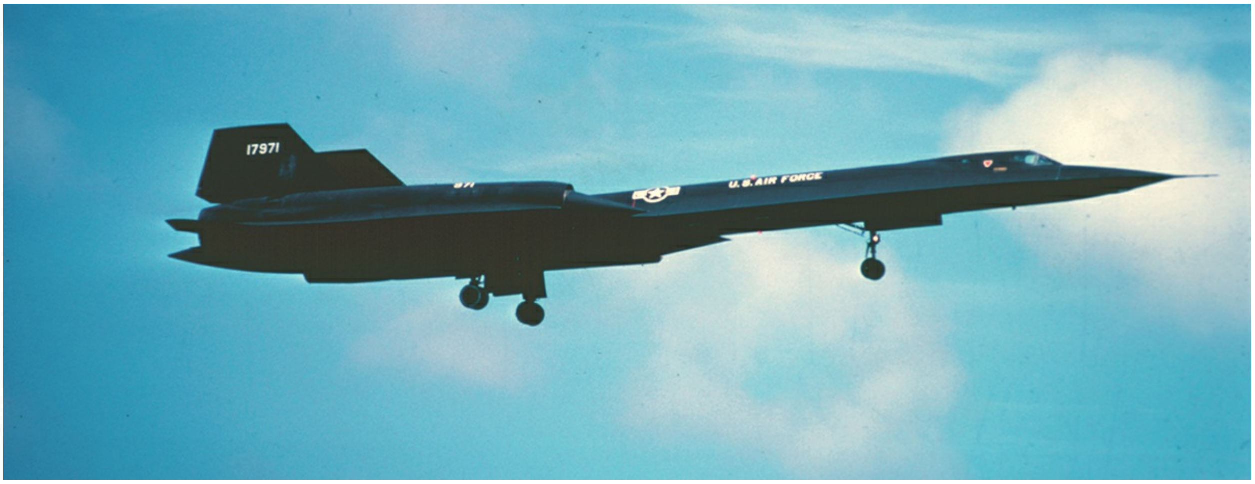
SS *MAYAGUEZ* INCIDENT

On Monday 12 May 1975, the US-registered freighter SS *Mayaguez* was stopped by a number of Khmer Rouge gunboats as it steamed in international waters some 60nm southwest of Cambodia, near the Paulo Wai Islands in the Gulf of Thailand. The merchant ship was boarded and the next day, under the control of its captors, moved to a point about two miles off the northeastern tip of Koh Tang Island.

The ship was initially located by two F-111s diverted from a routine training mission the day after its seizure. Thereafter, a round-the-clock surveillance plan was put into operation to monitor the *Mayaguez*'s movements. Just before dawn on 15 May, an assault was launched on two beaches at the northern tip of Koh Tang and a search made of the vessel in a bid to release its crewmembers. However, a small Thai fishing boat had been used to move the crew to the Cambodian mainland the day before, and the Marine boarding party found the freighter to be empty.

The assault force had gone ashore to encounter stiffer resistance than had been anticipated from a much larger and well-armed group of Khmer troops. To make matters worse, the 14-hour assault on Koh Tang cost the lives of 15 US Marines, with three missing in action (MIA) and 50 wounded, and four CH-53 helicopters shot down. Meanwhile, the same Thai fishing boat delivered the ship's crew unharmed to the destroyer USS *Holt*, in a gesture that seems to have been unconnected with the battle for their release.

The importance of the assault resulted in an SR-71 mission being scheduled to assess its aftermath. It was flown on 19 May 1975, by Capt Al Cirino and Capt Bruce Liebman in aircraft '961 and their take was to prove extremely useful during subsequent debriefings.



The growing capability of the detachment's maintenance facilities meant that after Majors Pat Bledsoe and Ronnie Blackwell touched down in '971 on 26 November 1974, it would remain on operations until 15 July 1976 before being returned to Beale. (Lindsey Peacock)

Despite the war in Southeast Asia having ended in August 1973, SR-71s from OLKA continued to conduct occasional overflights of Cambodia. Although never officially admitted, the large numbers of US troops listed as MIA continued to be a source of concern for the US government. This, together with occasional 'sightings' of MIAs and rumours of isolated prison compounds in inaccessible jungle areas, proved strong enough for various US intelligence agencies to request that flights be sanctioned.

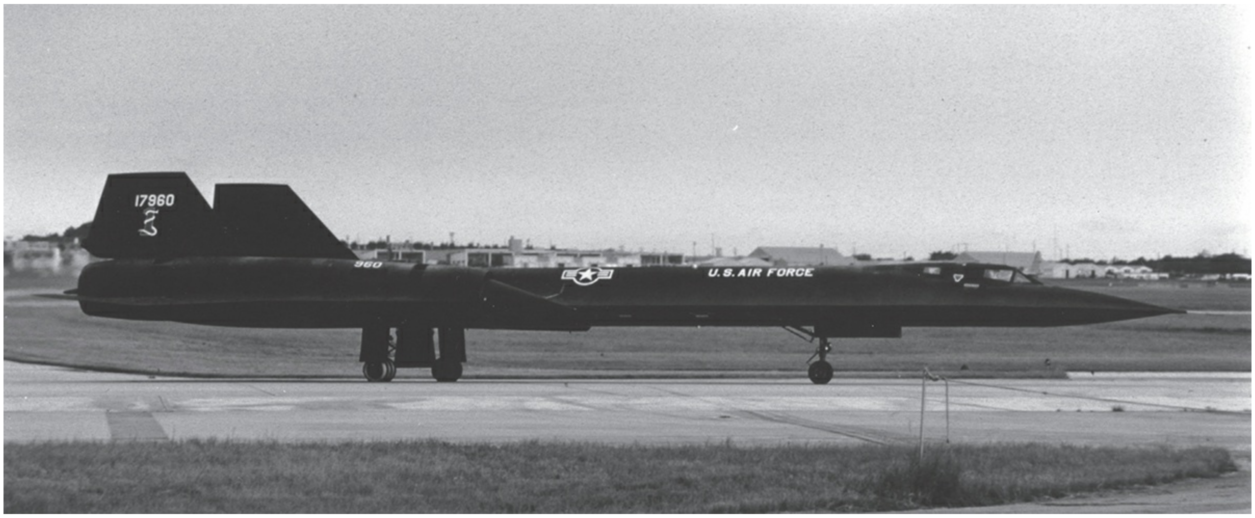
One such mission was flown by BC Thomas and Jay Reid in '976. The five-hour 48-minute flight was conducted on 24 November 1980, seven years after the cessation of hostilities. No substantive evidence was produced by the aeroplane's sensors to back up any speculation.

GIANT SCALE II

In May 1978, Vietnam began a series of border skirmishes with Kampuchea. In late December, these escalated into a full-scale invasion. Following the fall of Phnom Penh on 7 January 1979, the Vietnamese-backed rebel forces declared that Pol Pot and the infamous Khmer Rouge had overthrown the former regime and formed a government. However, fighting between rival factions in the west of the country continued, creating in the process thousands of refugees, who fled into neighbouring Thailand.

Concerned that an estimated army of 200,000 Vietnamese regulars in Kampuchea might turn their weapons on them, the Thai government requested reconnaissance coverage of the area from its long-standing ally, the United States. In total, five SR-71 sorties were flown in support of this request under the SAC codenamed Giant Scale II, the first by Tom Keck and Tim Shaw in aircraft ’979 on 17 February 1980. This was followed by Rick Young and Russ Szcepanik, again in ’979, on 3 May; Gil Bertelson and Frank Stampf completed a 6.2-hour sortie in ’976 on 3 August; Bob Crowder and John Morgan chalked up their mission in ’960 on 22 November; and BC Thomas and Jay Reid completed the series in ’976 on 24 November.

Each round-robin sortie from Kadena covered approximately 6,500 miles and required three air refuellings, one over the Philippine Sea and the other two over the Gulf of Thailand. All five were PHOTINT missions with the aircraft configured with an OBC unit in the nose and TEOCs in the chine bays. Four of the five sorties secured standard black and white imagery of the target area, but the JCS directed that the cameras for the mission flown in ’960 should be loaded with Kodak SO-131 camouflage detection film.



On 10 December 1977, during ‘960’s third operational deployment, Majors Rich Graham and Don Emmons completed a special coordinated mission with the US Navy codenamed Giant Barnacle. (USAF)

This film coloured healthy vegetation red and dead or dying vegetation various shades of grey and white. The result was used to gauge the probable yield of the rice crop, since Kampuchea had become a member of the United Nations in September 1980. After processing, the imagery was forwarded to the DIA where it helped plan the US contribution level to the food relief programme. The reconnaissance imagery collected during the other four sorties failed to reveal any large concentrations of Vietnamese forces or equipment along the Thai border and after sanitization it was passed, via the US embassy in Bangkok, to high-level officials in the Thai government.

ETHIOPIA

The Horn of Africa is an immensely important strategic location, guarding the Red Sea approach to the Suez Canal and overlooking the oil arteries of Saudi Arabia, Iraq, Oman, Kuwait, Djibouti and the United Arab Emirates as they fan out from the southern entrance to the Red Sea. In August 1977, a war broke out between communist-governed Ethiopia and its neighbour, Somalia. In November that same year, the Soviet Union began airlifting arms to Ethiopia and these were backed up by Cuban troops sent by Fidel Castro. By March 1978, it was estimated that approximately 11,000 Cuban troops were in country, and two Soviet generals were directing the ground war against Somalia.

The JCS directed that SAC should position a Kadena-based SR-71 to Diego Garcia, a small British-owned island in the Indian Ocean, and plan a round-robin PHOTINT reconnaissance mission over the area to monitor the extent of Soviet and Cuban presence. In response, the SRC prepared a track for such a sortie and the JCS directed that the flight should launch on 12 March 1978. However, the in-theatre situation changed dramatically early in the month, when Somalia suddenly withdrew its troops from Ethiopia and agreed to keep them out, provided that all foreign troops also consented to leave the region. The mission was therefore cancelled even before the SR-71 had been positioned to the island.

However, the event proved to be a catalyst in preparing Diego Garcia to support SR-71 contingency operations in the Indian Ocean area. The fragmentary order for these operations was initially codenamed Giant Cobra. Hangarage, for maintenance and to house the intel function, was provided by one of the SR-71 'barns' at Beale that was dismantled, transported to Diego Garcia in a C-5 and reconstructed on an apron stub. To expedite the positioning of JP-7, an air bridge consisting of KC-135Q tankers ferried in the unique fuel, from Clark AB, Philippines – a trip in excess of eight hours (utilizing an ocean-going tanker, would have taken a few months to organize – however, this would be the method used to replenish JP-7 stocks once operations got underway). Initially rubber bladders were used to store the fuel, but this was only a short-term fix, because JP-7 breaks down this type of storage. About two weeks into the preparations, Col Willie Lawson, 9th Wing Director of Operations, was selected to head the Operations, Maintenance, Base Supply and Intelligence teams, but at this stage, the flight crews were unaware who would fly the SR-71 into Diego Garcia.

To support this expanded operation, additional staff were required and drawn from various other SAC wings – none of whom had any previous experience of working in such a sensitive, high-energy environment. But it was anticipated that President Carter would most likely order an SR-71 mission to be flown from Diego Garcia sooner rather than later, so speed was of the essence. Once Col Lawson had assembled the state-side team, they left via KC-135Qs to Kadena. From there, it was decided who would go forward and who would remain at Okinawa.

Buz Carpenter and his RSO John Murphy were amongst other officers to accompany Col Lawson to Diego Garcia and prepare the island to receive the first SR-71, which would be flown in by Maury Rosenberg and his RSO Don Bulloch. But the arrival of about 100 additional personnel overwhelmed the small US Navy contingent stationed on the island. Furthermore, it was discovered that there was a vast amount of work to be done to make the base suitable for SR-71 operations. Barracks were identified, but they were about two miles from the airfield. Concrete overruns, that the newcomers thought could be used to extend the effective length of the runway for launching heavily loaded KC-135Qs, had been torn up, and the broken concrete pushed into 15–20ft high mounds, directly off the end of the runway, creating in the process a safety hazard. When Buz Carpenter conducted a runway inspection, he discovered that metal patches had been bolted on the runway, and the large bolt-heads protruded from the surface and were easily capable of puncturing an SR-71's high-pressure tyres. Then, about a week later, the new arrivals were joined by a Soviet picket ship, which began circling the island, monitoring the situation.

A long list of corrective actions was prepared and with the willing help of the US Navy, everything was made ready in just three weeks, and Col Lawson began receiving daily updates on the possible commencement of operations. Then one morning suddenly everything changed. The Soviet picket ship disappeared, then within a couple of hours, the 'detachment' received orders to return to Kadena. The team were dispersed back to their original bases and in the event, two years elapsed before an SR-71 stopped over and exercised the facilities on Diego Garcia.

The region again slipped into political upheaval when, in the face of a resurgence in Islamic fundamentalism, the pro-US Shah of Iran was driven into exile on 16 January 1979. Three months later, on 1 April 1979, Ayatollah Khomeini declared Iran to be an Islamic Republic. Khomeini was a zealot whose unquestioned devotion to Islam was only equalled by his all-consuming hatred for the West and, in particular, the United States. Since Iran was at the time a major oil exporter, it was decided to further bolster facilities on Diego Garcia in the event that national intelligence users required more extensive coverage of the area. Therefore, on 2 April 1979, the JCS directed SAC to create a permanent SR-71 fuel storage facility on Diego Garcia. Two 50,000 US gal polyurethane fuel storage bladders were deployed and filled by ten Kadena-based KC-135Qs in an operation codenamed Giant Ace.

On 1 May 1979, due to the deteriorating situation, a follow-on fragmentary order codenamed Giant Express extended the area of potential operations to include not only the Indian Ocean, but also Africa and Southwest Asia, as potential theatres of operations from Diego Garcia. Further developments on the island by the US Navy eventually freed up a 1.26 million US gal fuel tank for prospective SR-71 operations, which was filled with JP-7 delivered by ocean tanker.

THE US EMBASSY HOSTAGE CRISES

Iranian anti-US feelings grew progressively worse and when in October the exiled Shah was operated on in a New York hospital, Ayatollah Khalkhali urged Muslims to 'drag him out of his hospital bed and dismember him.' On 4 November 1979, relations between the United States and Iran were plunged into turmoil, when a group of militarized college students who supported the Iranian Revolution stormed the US Embassy in Tehran and held 52 United

States diplomats and citizens hostage. Compounding an already complex regional geopolitical situation, on 24 December 1979 the Soviet Union invaded Afghanistan.

On 24 April 1980, in an operation codenamed Eagle Claw, mounted by America's crack Delta Force, an attempt was made to free the remaining 52 diplomatic hostages. Alas, the audacious raid went catastrophically wrong and eight would-be rescuers were killed in the desert, 200 miles southeast of their objective. For President Carter it was an international humiliation.

The collection of intelligence concerning the hostages was codenamed Snowbird, and this continued, as did military planning for another possible rescue attempt codenamed Double Star. But the only substantial intelligence assets available to the US after the aborted April rescue attempt were satellites. However, various options for collecting further intelligence were contemplated, including leaflet dropping, although it's not apparent what such an activity would hope to achieve.

On 26 June 1980, a feasibility study and cost estimate schedule were requested from Lockheed ADP to provide an SR-71 with such a leaflet capability. This was supplied on 9 July, wherein it was envisaged that the system would be designed for internal installation in the existing TROC camera bay and be capable of dispensing 10,000 leaflets. It would be activated by air-charged initiators and powered by 1,000lb force actuators. Four systems, it noted, would be built, two flight-tested and two made available for operational use at a cost of $2.2 million. But nothing ever came of the idea.

Another plan involved US use of certain airfields near Tehran, from where a second rescue attempt could be launched. However, when it was learned that the Iranians might be attempting to block the runways of these airfields, the JCS requested that action be initiated to investigate the feasibility of an SR-71 overflying, using its HRR to define such obstructions. In response, an SR-71 mission was flown over Condron Army Airfield, White Sands, New Mexico on the night of 27 June when its runway was clear. A second sortie was flown over the same airfield on the night of 30 June, after a combination of vehicles, steel drums, tyres, rocks, wire cable, logs and dirt piles were heaped along the runway's edge.

A qualified photo interpreter then completed an analysis of the SR-71's HRR imagery to ascertain what level of obstruction could be detected. In a memo for the record, classified top secret and dated 9 July 1980, it was decided that the

CAPRE system was ‘capable of detection of runway obstructions expected to be of concern for project Double Star.’ In the event, intensive diplomatic efforts finally came to fruition on 21 January 1981, when the remaining 52 hostages were released after a mammoth 444 days in captivity.

DIEGO GARCIA REVISITED

In the summer of 1980, the JCS approved a plan to exercise the newly created SR-71 facilities should it prove necessary to launch further actions against Iran. Consequently, on 1 July, Bob Crowder and Don Emmons completed a four-hour 24-minute flight in ’962 to the island. The flight included three air refuellings, two from ’135s operating from Kadena and a third from tankers that had been deployed a week earlier to Diego Garcia. The crew returned ’962 to Kadena three days later.

Further political instability flared up in the region on 24 September 1980, when a simmering border war between Iraq and Iran evolved into full-scale hostilities, when Iraqi tanks and troops crashed across the border. Their dawn attack set the world’s largest oil refinery, and many of Abadan’s oil storage tanks, ablaze. The Iraqis quickly seized the port of Khorramshahr, and advanced 10 miles into Iranian territory. Despite initial successes by the Iraqi army, the conflict soon turned into stalemate, with both sides digging in and fighting a long and bloody trench war, not too dissimilar to the battles fought in Europe some 65 years earlier.

Both the USSR and the US made it clear that they would remain ‘strictly neutral’. However, the US intelligence community fully understood how easy it would be for Iran to exploit the ‘oil pressure point.’

On 3 November 1980, Maj Gen James B. Vaught of the JCS submitted a top secret memo to the Joint Reconnaissance Centre, the subject: *SR-71 Mission Request*. It set out the following:

> 1. Request consideration be given to conducting several SR-71 surveillance missions of the Persian Gulf during the next 3–6 weeks.
> 2. Purpose of mission is to determine locations of major oil-rig concentrations and typical flow pattern of Gulf shipping to assist in selection of low-level air penetration routes.
> 3. Recognize that missions could raise Soviet/Iran/ME speculation; however, given irregular scheduling, direct association with any US military planning will probably be low. On the other hand,

> periodic SR-71 missions would provide 'reason' for increased tanker support in the area prior to the execution of any US military contingency action.

Despite the request, immediate action wasn't forthcoming and a number of years would elapse before Det 1 was tasked to undertake these Persian Gulf missions. So, on 14 January 1981, Majors Buz Carpenter and his RSO Tim Shaw flew '960 from Det 1 to Diego Garcia in 4.1 hours, on what would prove to be the last visit of an SR-71 to the island. It wasn't, however, without incident, as Buz recalls:

> We had an interesting Astronav glitch, because maintenance did not load the southern star catalogue. So, as we crossed the equator heading southwest, all our star-tracking came to an end and we had to do some Mach 3 dead reckoning until we could pick up the Tactical Air Navigation (TACAN – radio navigation aid), on the Island. The two missions that flew into Diego Garcia were probably the only occasions that an SR-71 had flown south of the equator, and maintenance had forgotten that Diego Garcia was in the Southern Hemisphere. The next day, when we left, they had me climb to near altitude over the island after refuelling, take a known fix and then a northeasterly heading and figured as we approached the equator, this time our northern star catalogue would see the correct stars and our Astronav system would resume tracking – which it did, and the rest of our 4.8hr flight back to Kadena was without incident.

CHINA AND THE SOVIET UNION

The U-2/Gary Powers shoot-down and subsequent promise made by President Eisenhower not to overfly the Soviet Union ensured that neither the A-12 or SR-71 would perform such missions. Likewise, when President Nixon became the first American president to ever visit mainland China in February 1972, he made a similar promise to the People's Republic of China (PRC). However, Det 1 regularly and successfully performed peripheral mission against both countries. Despite the fact that these stand-off flights were conducted in international airspace, the Habu crews that flew them remained convinced that given the opportunity, Soviet fighters would attempt a shootdown and their pilots argue about the aircraft's position afterwards. There's little doubt that such flights caused acute irritation to the Soviet leadership.

On 29 October 1979, Maj Rich Graham and Maj Don Emmons were airborne from Kadena in '962 on just such a stand-off flight. Nearing Petropavlovsk (on the east coast of the Kamchatka peninsula) they observed two medium-altitude circular contrails ahead of them. As they continued, the two

MiGs attempted a snap-up manoeuvre, but were unable to get close to the Habu. Rich and Don later observed four more contrails, belonging to MiGs whose pilots were waiting to attempt a similar intercept. Rich said to Don, 'Let's show them that we know they're there and that we don't care.' Rich dumped a small burst of fuel that created a high, fast vapour trail. No attempt was made by the MiGs to intercept the 3,000ft-per-second target that passed high above them. Such potential intercept actions were typical of activity that greeted many stand-off flights during the Cold War.

ANOTHER DET REDUCTION

Tasking for Senior Crown in the Far East continued to decrease, together with funding for the number of Primary Authorised Aircraft (PAA). As a result, during Glowing Heat, the aircraft swap-out between 6 and 30 June 1982, aircraft '976 and '967 were ferried back to Beale and replaced by '980, thereby reducing the Det's complement from three to two SR-71s ('975 remained in place at the Det).

There were few possible track variations for a stand-off sortie; crews could essentially fly up or down a coastline, or fly towards it and break away to the left or right. To keep the Soviet defence controllers guessing, Lt Col Tom Alison, at the time the Det 1 commander, thought up an innovative sortie with a difference.

On the morning of 27 March 1984, Maj Stormy Boudreaux and Maj Ted Ross got airborne from Kadena in '964 and headed northeast towards Vladivostok. Back at Beale AFB, Lt Col Les Dyer and Maj Dan Greenwood launched in '973 and headed for deployment to Kadena via Vladivostok. In a masterpiece of co-ordination and choreography codenamed Busy Relay, the two aircraft streaked towards one another from opposite directions at a closure speed of Mach 6, their courses crossing just 3 miles apart.

Stormy and Ted then turned right to trace Les and Dan, who proceeded them south and then west across Korea just south of the demilitarized zone. As expected, the appearance of two SR-71s off Vladivostok triggered a series of atypical reactions from the region's numerous radar sites, and the ELINT collecting systems of both SR-71s and an RC-135 also sent to the area yielded a rich SIGINT harvest.

A CLOSE CALL…

Accumulating SR-71 flight hours wasn't easy for the crews given the highly regulated missions flown especially from the Dets, however, one more extra circuit could have resulted in the loss of an aircraft, as Skip Holser recalls:

> We were at Det 1. The aircraft taxied back into the hangar per norm, the crew shut down the number one engine and the crew chief performed the after flight, flight control checks as per the procedure. Suddenly the number two engine just shut down on its own. No fuel is dumped out of the drain as is always the case in a normal shutdown. The engine just stopped.
>
> We hooked-up external ground power and I got into the cockpit to check the fuel quantity. The fuel indicator totalizer indicated 9,800lb of fuel still onboard, which is very low for landing. I checked the individual fuel tanks numbered 1 through 6 and they indicated empty.
>
> While the pilot was flying nose up, the remaining fuel was getting to the fuel boost pumps. But when he landed and taxied back with the aircraft level, there wasn't enough fuel remaining to get to the fuel boost pumps. Start/stop switches shut off the boost pumps when the fuel remaining is too low, to prevent the boost pumps from overheating and burning themselves out (fuel is used as cooling for the pumps). One more touch and go and he would not have made it back – very lucky!
>
> We had to do a complete fuel sequence check of the fuel boost pumps which entails refuelling tanks 1-3-6B to a minimum of 3,000lb and tanks 2-4-5 to a minimum of 2,000lb of fuel to make sure the start/stop switches and fuel boost pumps cycled on and off as per the maintenance manual.

CONFRONTATION NORTH KOREA

Three reconnaissance sorties were flown over North Korea by Oxcart pilots in 1968, the task passing to SAC as a long-term role in early 1968, when the 9th SRW's OL-8 (OLRK) inherited the CIA's facilities at Kadena. The principal objectives of these Western Pacific or WESTPAC missions were to gather 'Indication and Warnings', with most of the operational objectives achieved from international airspace off the North Korean coast or over the demilitarized zone (DMZ). Such missions were launched to satisfy the requirements specified primarily by the Commander in Chief Pacific (CINCPAC), on behalf of the intelligence users who operated under his jurisdiction, the most important of whom were Commander US Forces Korea (COMUSKEA), Commander in Chief, Pacific Fleet (CINCPACFLT) and the Intelligence Center Pacific

(ICPAC).

The justification for designating this region as a principal area of operations was based upon the fact that an armistice between North and South Korea had never been signed at the end of the Korean War (meaning that technically, the two nations were still at war with one another). In addition, by 1977, North Korea had an army of 450,000 men (by mid-1978, the DIA and CIA believed that this number had increased to between 550,000 and 600,000), which made it the fifth largest army in the world. Furthermore, the country's unpredictable dictator at that time, Kim Il Sung, was committed to reunification of the peninsula under his form of communism.

Admiral Maurice Weisner, CINCPAC, believed that given the sophistication of North Korea's weaponry and the level of training undertaken by its troops, the North could order an attack across the DMZ at virtually any time. He therefore requested the JCS, which in turn directed SAC, to increase the number of monthly SR-71 monitoring sorties to the area from eight to 12. The SRC then scheduled the SR-71 to be configured with cameras on two of the sorties and to gather RADINT, using its HRR, and ELINT on the remaining ten. The PHOTINT provided a reference base for intelligence specialists to use when interpreting the HRR imagery.

North Korea's propensity to relocate or reinforce its military units and installations along the DMZ at night prompted further requests from US theatre commanders that the majority of these SR-71 'indications and warning' sorties be conducted at night. This was communicated by the JCS to the SRC, and at 9.05pm on 19 September 1977, Jack Veth and his RSO Bill Keller left Kadena in '960, returning 4.1 hours later having completed the first night monitoring sortie of North Korea.

Four additional RADINT/ELINT night sorties of North Korea were completed before the end of the year (27 September, by Kinego and Elliott in '967; 16 and 25 November by Alison and Vida in '967 and '960; 13 December by Carpenter and Murphy, again in '960). The crews that flew these important missions were less than impressed by their nocturnal forays, noting that the aircraft's cockpit lighting was uneven, causing reflections that made monitoring instrumentation extremely difficult and potentially dangerous, especially during the descent phase to rendezvous with a tanker. This situation could be further complicated by a lack of horizon; such conditions could well trigger vertigo and pilot disorientation, leading to the loss of an aircraft.

During an operational mission over the Korean DMZ on 26 August 1981, '976 was fired upon by an SA-2. (Via Tony Landis)

Therefore, after the first two sorties flown in September, the mission profile was amended and the number of air refuellings reduced from two to one. The decision reduced the number of passes made through the sensitive area from two to one, which in turn also reduced mission flight time from 4.5 to approximately 2.5 hours. Finally, in a further move to alleviate the problem, three missions were flown at Mach 2.8, reducing turn radius and enabling bank angles to be restricted to a maximum of 35°.

The situation was finally rectified in 1982, when the cockpit lighting was improved and Peripheral Vision Horizon Display (PVHD) units were fitted in the SR-71 fleet. These projected a thin red line of light across the aircraft's instrument panel to produce an artificial horizon that responded to changes in pitch and roll, thereby duplicating the behaviour of a natural horizon.

In April 1981, SR-71 flights began collecting ELINT cuts and other raw data on a suspected SA-2 site that was under construction on the island of Choc Tarrie in an estuary near the western end of Korea's DMZ. In July, Maj Maury Rosenberg and his RSO Capt Ed McKim arrived at Kadena to begin their first operational TDY together as a qualified SR-71 crew (although this was Maury's second SR-71 tour). Both Maury and Ed were very experienced aviators. Prior to being selected for Senior Crown, Maury had completed combat tours in Vietnam as an F-4 pilot and Ed as a B-52 Radar Navigator, so both had been shot at and flown in 'harm's way'. By late August, they'd flown a few sorties through the DMZ and had received radar signals from the suspected missile site.

The SAM site was capable of spoofing the aircraft's DEF systems by simulating tracking, locking on and firing a missile. It could even send spoof guidance command signals to the missile. For this to happen there had to be a site on the ground, but whether it was operational and had missiles was difficult to determine.

The SR-71's DEF systems were extremely sophisticated and had the ability to intercept the guidance signal and identify if the missile responded, which would mean it was definitely airborne and on its way. Once the DEF system confirmed missile guidance responses, the RSO would initiate its full jamming capability.

On 25 August, Maj Nevin Cunningham and Gene 'Geno' Quist climbed into '967 for a two-loop sortie of the 'Z' area. Before each flight, Det 1's intelligence officer kept crews appraised of the SA-2 site's most recent developments, as it was becoming increasingly apparent that the North Koreans were about to embark upon another 'adventure in belligerence'.

ROSENBERG/MCKIM

Captains Maury Rossenberg (left) and his RSO Ed McKim were fired at by an SA-2 on the final mission of their first operational tour together. (USAF)

17967
U.S. AIR FORCE
17960
U.S. AIR FORCE

On 26 June 1982, Majors Burnie Smith and his RSO Denny Whalen were preparing to take 61-7980 on an operational mission to monitor North Korea. Also on the Kadena run-up area were Majors Lee Shelton and Russ Szczepanik in 61-7967, as they conducted checks prior to a functional check flight. (USAF via Tony Landis)

Although it was clear over the target area, the primary sensor for this four-hour sortie was the SLAR. During their fourth and final pass over the DMZ, the crew found themselves carrying excess fuel, so Nevin flicked his fuel dump switch in quick Morse code bursts that spelled out a four-letter expletive for the benefit of the North Korean ground trackers attempting to follow the SR-71 visually. Their humour was probably lost on the enemy, but it brought lots of laughs back at the Habu bar at Kadena.

The next morning, Maury and Ed were briefed a three-pass mission along the DMZ. This was to be the last flight of their tour before heading back to Beale in a tanker. Once again they were told about the suspected SA-2 site, at which Maury asked the intelligence officer: 'Who determines when a suspected site becomes a confirmed site?' He was told that the Defense Intelligence Agency made the final call on such issues, and asked, 'So what do we have to do before we can confirm it? See a missile?' The intelligence officer replied, 'Well, that would surely help'.

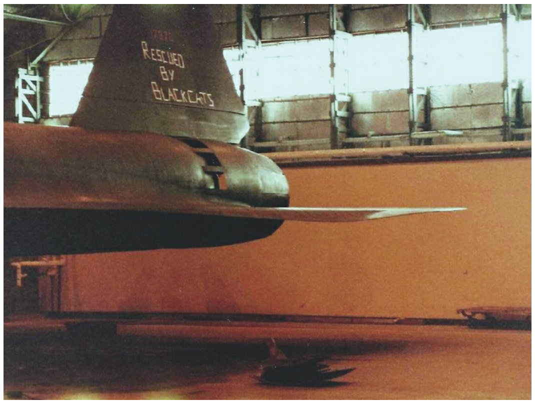
Maury and Ed launched in '976 on their 'Z' sortie and headed for the first air refuelling. After tanking they flew through the Straits of Formosa and made their first pass from west to east along Korea's DMZ. They then turned south and flew down the east coast of South Korea toward their second refuelling. Thereafter they reversed course and after reaching operational altitude off the west coast of South Korea, they repeated their west to east run across the DMZ. Coasting out to the east, Maury made a right and left 90–270° turn, which put '976 on an east to west pass.

Approaching the western side of Korea at Mach 3 and 77,000ft, Ed remarked that he was getting some DEF system activity, and that 'everything was turned on'. In the next breath he exclaimed, 'Wow! It looks like we've had a launch'. Maury accelerated to Mach 3.2 and told Ed, 'I see a contrail! I'll be damned, it's coming right at us'. Maury made a slight turn to the left away from the rising contrail, which took them further into South Korean airspace, and watched as the SA-2 missed by a good 2 miles, exploding behind and to the right at about 80,000ft.

Always mindful of the sensitivity of such sorties, the US authorities monitored these SR-71 flights very closely. Almost as soon as ’976 came off track, Ed received an encoded HF message from Sky King concerning the track deviation. There was no mention of the hostile missile firing. The RSO responded with the appropriate messages but found there was not a specific coded message that could be sent alluding to the missile incident. As a result of this mission, a coded message format was later added should a crew find themselves in similar circumstances. It was not until the Habu crew arrived back on ‘the Rock’ that they could inform the staff they had been shot at.

The incident was of such importance that a coded message was dispatched to all interested agencies, including the National Security Council. Secretary of Defense (SECDEF) Casper Weinberger informed the president of the firing, and a series of high-level briefings followed. Deputy Secretary of Defense Frank Carlucci recalled that President Reagan was ‘furious’ over the incident. Meanwhile, Dean Fischer, a spokesman for the State Department, said, ‘The Reagan Administration roundly denounces this act of lawlessness,’ adding that the attack violated ‘accepted norms of international behaviour’. Despite faultless photographic evidence of the North Korean missile firing at an aircraft over South Korea, the North Korean government denied the missile charge. While the diplomatic rhetoric continued, Det 1 was told to move the reconnaissance track flown by the SR-71 even further to the south. Six days later, Nev Cunningham and Geno Quist flew a typical four-hour, two-loop sortie along the ‘Z’ in ’976, with little reaction.

Maj BC Thomas and Maj Jay Reid arrived at Kadena during the period of high-level interest in the Det’s Korean activity. On 26 September, Deputy SECDEF Frank



On 23 January 1984, Majors Joe Matthews and Curt Osterheld diverted ‘976 into Osan, South Korea.

Whilst in the hanger, the Black Cats left their calling card. (Joe Matthews) Carlucci visited the island and was briefed on their operations and shown an SR-71 for the first time. Carlucci met with the Habu crewmembers and explained that the DMZ route package had been moved further to the south for the moment, but that they would return to their former DMZ routes after 'certain preparations' were made. He did not explain what those preparations were, but seemed angry about the attempted shootdown. He added that the US government viewed such hostile actions with serious concern, and emphasized that the president would not stand for a repeat.

On Friday 2 October, BC and Jay flew '967 on a sortie off the eastern coast of China, North Korea and the USSR. They reported an unusual massing of ships off the coast of North Korea. The next day, Lt Gen Robert Mathis (the Air Force Assistant Vice Chief of Staff) held a special briefing for the Det's crewmembers in which he told of four special category missions that were to be flown on routes following the same triple-pass track that Maury had flown when he was shot at on 26 August.

He emphasized that the timing would be extremely important, and that the Habu was to be over the earlier mission's firing point within 30 seconds of the mission's pre-planned timing. Timing control triangles would be built into the flight track after the second air refuelling to ensure that the precise constraints were met. One of the pilots asked why timing was so important. General Mathis explained that Wild Weasel anti-radar strike aircraft would be poised to hit any North Korean SAM site within 60 seconds of a launch against the SR-71. The time constraint would ensure that the strike aircraft were headed in the right direction at the moment a missile was launched. President Reagan had personally approved the plan.

Operational sorties to the 'Z' continued to be flown along the amended route until Monday 26 October 1981. Following extensive mission planning and detailed briefings, BC Thomas and Jay Reid took off from Kadena exactly on time in '975. All four of these high-priority missions were ground-spared as insurance against an abort of the primary aircraft. BC recalled:

> We had to employ the timing triangles to lose a few minutes of 'pad'; we also delayed with the tanker all the way to the end of the second air refuelling for the same reason. We flew over the critical point within ten seconds of the designated time, feeling very proud of ourselves.
>
> We all felt that this mission, which had such importance attached to it, and all of the preparation that had gone into it, to be the pinnacle of our professional efforts. Even though there was no firing, I experienced the greatest sense of well-being, knowing we did the whole operation exactly as planned. I must admit that I'd hoped that the North Koreans would fire at us. Their missile capability never bothered us, and I believe that it is fair for me to say that by immediately smashing their launch facility, our national resolve would have been most graphically demonstrated.

For whatever reason, the North Koreans chose not to launch a missile at this or any other trawling mission, and BC and all who followed him recovered safely after each four-hour flight.

A TESTING FIRST TOUR

The profile devised to monitor North Korea meant that crews new to the Senior Crown programme would initially ‘cut their operational teeth’ in this theatre, rather than in the more constrained airspace over Europe. Capt Joe Matthews and his RSO, Capt Douglas ‘Curt’ Osterheld, certainly had an ‘interesting’ first operational deployment in early 1984 as Curt recalls,

> I was privileged to fly with Joe Matthews as my front seater and accomplice in numerous adventures. Joe was a superb pilot. We’d served together before in RF-4C Phantoms, an aircraft which is deserving of its own book full of flyer’s tales. We’d had our share of emergencies during our training at Beale, but that really is to be expected. The simulator and student sorties were intended to build not just your knowledge of the jet, but confidence that you could handle whatever the airplane had in store for you. It’s only fair to reiterate that since each SR-71 was handcrafted, each aircraft had something different up its sleeve for the unwary.

Arriving at Kadena by tanker, they were airborne a couple of days later in ’964 at 11:00am Local (L), on the familiarisation route designated ‘New Debbie’. During this sortie, they exercised the aircraft to Mach 3.0, 78,000ft and some 2 hours 48 minutes later, they were back in the circuit, shooting practice approaches, when they experienced a ‘Left and Right Hydro’ failure. As per the book, they landed immediately. A subsequent inspection confirmed that the left (L) hydro system had failed.

Two days later, they were airborne in the same aircraft when again, they were forced to terminate the sortie after 50 minutes, due to an HF radio failure. The next day, 20 January, was their operational debut. Mission route code Giant Scale 1003 (GS-1003) was a multi-pass mission, set three nautical miles south of the DMZ between North and South Korea. On this occasion ’964 performed flawlessly and they completed the 4,860 mile-sortie in 4 hours 18 minutes. Back at the Det 1 bar, the occasion was marked by Joe and Curt bying drinks all round and being presented with the coveted Habu patch, which they were now qualified to wear on their flight suits.

On 23 January, Joe and Curt left Kadena at 1:00pm in ’976, for their second surveillance flight of North Korea, coded GS-1000. Having completed their first East-to-West, they'd just initiated a left turn, which when completed, would have lined them up for a West-to-East run, when Joe told Curt that the Oil Quantity light had illuminated – this was another land asap situation. Mindful of the cost involved in recovering an aircraft from a land-away, they briefly toyed with the idea of continuing the turn onto a heading for 'home plate'. However, given that this was only their second ops sortie, Curt grappled to retrieve the HF codes from the leg-pocket of his pressure suit that he'd use to inform the Command Post at Kadena and the SAC Recon Centre, that they were aborting into Osan, South Korea. Landing one hour 30 minutes after take-off, their decision to abort was vindicated when large oil stains were discovered. Osan was the home of the 9th SRW's Det 2, known as The Black Cats and there was plenty of banter between the U-2 and the HABU crew. Curt diplomatically secured hangarage and security for '976, spare flight suits, since the only clothes they had were their pressure suits, and BOQ accommodation.

The next day a KC-135 tanker arrived from Kadena with a recovery crew and all the spares necessary to get '976 back to Okinawa. On 25 January and in sub-zero temperatures, all was ready for the subsonic return flight. Buick start carts were hooked up, engine oil had been slowly heated over several hours by the ground crew, transforming it from a tar-like consistency to a more viscous state and steps to the cockpits had been removed. The crew then noticed a parade of staff cars arrive. Steps were once again positioned to the aircraft and an uncomfortable-looking Det 2 commander explained that three very senior South Korean Air Force generals in the cars had been given special security clearance to look over the SR-71. Despite explaining the practical necessity of taking off asap, US and South Korean relations trumped the situation. So, with Joe and Curt remaining in the cockpit, a brief impromptu tour occurred, after which the esteemed visitors claimed that they had clearance to sit in the cockpit and have their photographs taken! At which point Joe and Curt almost had a sense of humour failure. They reinforced their earlier statements that if they didn't leave toot-sweet, the engine oil would once again have to undergo the slow reheating process, which would delay their departure for hours and besides which they were very concerned about the amount of secret material in the cockpits. Their objections worked and at 12.14(L), '976 left Osan for the one hour 30 minutes flight back to Det 1.

Curt Osterheld and Joe Matthews were more than thankful for their thorough simulator training back at Beale during their first operational tour to Det 1. (USAF)

Joe and Curt's crew chief presented them with a 'lucky rabbit' mascot, in recognition of their demanding first tour. Curt flew with it in his pressure suit leg pocket for his entire time on the SR-71 programme. (Curt Osterheld)

27 January proved kinder to the two 'newbies' and '964 ensured that they chalked up 4,168 miles whilst successfully completing their third operational mission flying route GS-1031 – again monitoring the activities of North Korea. However, '964 was having none of it four days later, when the new crew attempted again to complete route GS-1003 as Curt eloquently explains:

> The mission objectives were to perform electronic intelligence gathering over the Yellow Sea, then make a standard photo run over the Korean DMZ. Everything was pretty routine through the first air-to-air refuelling. Then, during the climb to operating speed and altitude, we began to encounter some moderate clear air turbulence. From the cockpit, this feels much like sitting on the end of a diving board as it oscillates up and down. At approximately 45,000ft and Mach 1.4, there was a severe jolt that knocked our helmets against the canopy. After that, the air seemed to smooth out and we continued the climb/acceleration.
>
> At Mach 3 and 79,000ft, we seemed to be well on our way when, for seemingly no reason, the

autopilot disengaged. Our centre of gravity was not where it was supposed to be and fuel readings were erratic. Joe was fighting with the pitch trim and the autopilot would kick off just as soon as it was engaged. I was using the manual circular computer to 'spin' the CG over and over again, not believing the calculations.

Now we were 4,000lb down on the fuel curve, or our planned amount of fuel for a specific point in the mission. Then 5,000. Then 6,000. Joe was using the small periscope to scan behind the aircraft for fuel leaks, but with its very limited field-of-view could see nothing abnormal. Again, the autopilot kicked off. And now the nitrogen that served as our inerting atmosphere for the fuel tanks was depleting rapidly.

Our options became very limited. With our remaining fuel, we couldn't continue with the mission and had to abort back to Kadena; truly a disappointing choice to make, since you are admitting failure. I made the required abort calls over the HF radio, telling the whole world we were heading home a lot sooner than planned.

The descent was spiced up with a couple of unstarts, but finally we were subsonic and only 80 miles away from Kadena. The mysterious fuel loss had stabilized and it seemed that now we could make a 'normal' recovery. There were a few brief moments for Joe and me to discuss 'what the hell was all that?' and other topics before talking with approach control. Both of us were wondering what we had done wrong… and what would be the detachment commander's reaction.

Joe made a great landing, which was followed quickly by an expletive over the intercom and news that the drag 'chute had not deployed. Some judicious use of the SR-71's powerful brakes got us stopped and we didn't have to use the emergency barrier. The barrier was a large diameter cable that pops up from the runway and catches the two main gear struts. I imagine the effect on the landing gear doors would have been very ugly.

Taxiing in, we ran the appropriate checklists and wondered 'what next?' As we pulled into the hangar, a number of the maintenance folks were pointing, wide-eyed, to the back of the aircraft.

After shutting down the engines, we had a large contingent of folks swarming over the airplane. Joe and I climbed out, took off the Lockheed ejection seat 'spurs' from our boots and put on protective boot covers. On the right wing, near the fuselage, was a jagged 10in. gash that looked like it had been made with a can opener. The drag 'chute that hadn't deployed on landing was missing altogether, as was the right drag 'chute compartment door from the top of the fuselage.

So we began to piece the mystery together. That jolt of clear air turbulence we felt at 45,000ft popped the right drag 'chute compartment door open and, once it was in the slipstream, it punctured the right wing and fuel tank 6 as it departed the aircraft. The drag 'chute was then sucked from its shallow tub along the top of the fuselage.

The genius of Kelly Johnson's engineering was evident here. The large drag 'chute was connected to the aircraft by a ball-and-jaws type joint. The jaws only closed around the ball when the pilot pulled the drag 'chute handle. Therefore, when the drag chute compartment door opened accidentally, the drag chute, still in a bundle and not attached to the jet, could fall away free from the aircraft. One can imagine the aerodynamic loads placed on the aircraft, even for a brief time, if the chute deployed at supersonic speeds, connected firmly to the middle of the aircraft!

The gash in the wing/fuel tank explained the rest. Approximately 6,000lb vented through this hole, along with the nitrogen. This upset the delicate balance of the CG and caused erratic readings as the fuel transfer system attempted to fix the imbalance. This would cause transients in the pitch trim, which in turn would automatically disengage the autopilot. All very logical when you're standing on the ground.

This whole experience did have an upside. The instructors in the simulator now had a baffling new scenario with which to humiliate their students. Joe and I received little pink bunnies from our senior crew, to provide us with four 'lucky rabbit's feet' so something like this wouldn't happen again. We

> were beginning to feel like experienced Habus, even if it was just our first tour!

S/Sgt Skip Holser and his maintenance team were on the flightline that day awaiting the return of '964 as he recalls,

> The aircraft returned from flight and the drag 'chute didn't deploy on landing. Once I was back in the hangar and shut down the engines, I got on top of the fuselage drag 'chute area and immediately noticed that the right drag 'chute door was missing, but the left door was still in place. As the right door was ripped off, it had cartwheeled down the right upper wing and punched four holes through the top of fuel tank 6B. The first hole I could actually put my hand in, the next three were smaller.
>
> Usually, the first to get blamed for this sort of thing was maintenance, as the 'chute is always installed by the Organizational Maintenance Squadron (OMS) ground crew guys. Luckily, this drag 'chute had been installed during a Quality Assurance (QA) evaluation and it had been passed without any errors.
>
> The drag 'chute doors have a bayonet rod system that extends and retracts into cut-outs in the forward and aft end of the fuselage drag 'chute door area. They are opened and closed by electric motors. Too much turbulence over the drag 'chute door area can cause the bayonet rods to vibrate and retract on their own, allowing the door to open inflight. When this happens, the drag 'chute deploys and is automatically jettisoned, since it's not locked to the aircraft until the pilot pulls the drag 'chute handle on landing, a sort of a failsafe feature. A new door was installed and a complete drag 'chute door system rigging was performed per the maintenance manual.

Majors Duane Noll and Tom Veltri hold short of the main runway before taxiing for take-off during an operational sortie in '968 on 10 September 1986. (USAF)

> There was one other time back at Beale, when the SR-71B '956 had one drag 'chute door come open at speed (the other stayed closed) and the drag 'chute melted inside the drag 'chute compartment liner.

The next day Joe and Curt were airborne on route GS-1001, a 2-hour-18-minute sortie in '976, and completed their fifth ops mission. Their sixth ops sortie, on route GS-1030 was again in ’976, and was completed on 6 February. It was the crew’s first operational night sortie, which again was flown along the DMZ without issue. They were now on a roll and their ops sortie lasting 2 hours 30 minutes on route GS-1000 in ’964 on the 10 February also went as planned. Five days later, however, ’964 had another little tantrum. They’d just cleared the collection area during another monitoring sortie of North Korea, this time on route GS-1030 when Curt’s attention was drawn to a flashing MAL light on the ANS control panel, indicating that it had malfunctioned. Curt recalls,

> There are various routines one can go through to trouble shoot the ANS, but at this juncture we were ready to commence our descent and landing at Kadena. So I elected to switch from Astro inertial to INS mode. That provided us with a stabilized attitude reference to complete the flight. We were without the navigation error correction provided by the star tracker, but we had adequate INS information to get us to Kadena. Happily, the descent and landing at Kadena went without incident.

Finally, as if to show that there were no hard feelings and that the new kids on the block had earned their spurs, ’964 provided a fault-free platform for Joe and Curt’s final flight of their first operational tour on 21 February – another North Korean night mission, flown along GS-1001 and lasting 2 hours 30 minutes, after which they were back on the tanker to Beale with nine ops sorties in their log books and a bag of experience from which to draw in future.

GIANT EXPRESS

On 24 May 1984, two Iranian aircraft attacked an oil tanker off the Saudi Arabian coast. As East-West counter-charges continued over the next few years, Iraq’s jets attacked the key Iranian oil terminals on Kharg Island and the Iranians attacked oil-laden super tankers bound for the West from Kuwait, Saudi Arabia and Bahrain. To offer greater protection to these unarmed vessels, the US government planned to reflag such vessels as American ships and escort them through the choke point at the Straits of Hormuz.

On 18 May 1987, two Iraqi Mirages F1s, each carrying an AM.39 Exocet anti-ship missile, locked onto a surface target in the waters north of Bahrain. They fired their sea-skimming missiles 12 miles from the target; the warhead on one of the weapons failed to explode. The other missile, however, worked with devastating effect, hitting the frigate USS *Stark*, killing 28 sailors and leaving the sleek warship disabled and burning. President Reagan immediately demanded an Iraqi explanation for the attack, which a Baghdad spokesman said was due to the pilots identifying the frigate as Iranian.

During Admiral Crowe's tenure as the 11th Chairman of the JCS, tension in the Persian Gulf region continued to mount as a result of the Iran-Iraq War. In 1987 he was actively involved in planning Operation Earnest Will, the US reflagging and convoying of Kuwaiti tankers in the Persian Gulf, to protect them from Iranian attack. Furthermore, it's understood that he specifically requested that the SR-71 should be used to monitor Iranian activity in the region should it be deemed necessary, despite this being against Gen Welch's objections. There's no doubt that Admiral Crowe was well aware of the SR-71's sensor collecting abilities whilst he served as Commander-in-Chief United States Naval Forces in Europe in 1983, and the SR-71s at Det 4 were kept busy keeping tabs on the Soviet Northern Fleet.

Majors Larry Brown and RSO Keith Carter ferried '979 into Kadena on 3 July 1988, having completed an operational mission to monitor the Soviet fleet en route. The aircraft stayed for a relatively short time before being ferried back to Beale on 12 August by Lt Cols Rod Dyckman and RSO John Manzi. (USAF)

Majors Mike Smith (right) and his RSO Doug Soifer completed the first Giant Express flight to monitor the situation in the Straits of Hormuz on 22 July 1987. (USAF)

As the situation, continued to escalate, on 22 July 1987 Majs Mike Smith and Doug Soifer flew the first of four very long non-stop reconnaissance missions from Kadena into the region codenamed Giant Express. Majors Ed Yeilding and Curt Osterheld backed them up as spare crew in ’967. As the primary crew stepped from the PSD van towards ’975, Col Tom Alison and Lt Col Tom Henichek (the Det commander and ops officer) informed them that ’975’s ANS had not checked out properly and they would have to take ’967 instead. Ed and Curt would follow in ’975 after its ANS problem was resolved.

The 11-hour sortie would involve two refuellings on the outbound leg and three on the return. As Mike and Doug approached their second aerial rendezvous, Doug called Ed and Curt, who were two hours behind in ’957, and told them that everything was progressing well and their services would not be required that day. The most distant second and third tankings were to be carried out with three KC-10s before and after ’967 had flown over the ‘cuckoo’s nest’. The KC-10s were able to extend their range by buddy refuelling each other. As a result of this, Mike was able to take on distant, pre- and post-target, split onloads from the two tankers during each AR.

The cloud cover had been almost continually undercast since they left Kadena, and since ’967 was equipped with Technical Objective Cameras and an Optical Bar Panoramic Camera, it looked as if the mission could prove to be a very expensive failure. After much ‘gas guzzling’, they headed out high and hot to boom the Gulf region; then suddenly, the undercast disappeared and conditions were perfect for the high-resolution cameras to do some of their finest work.

Their fifth and final AR was completed ten hours after take-off. That night refuelling was complicated by the failure of one of the KC-10's boom lights, which made proper formation flying (in the close-in contact position) very difficult. Despite that added strain to an already tiring flight (at the near limit of an SR-71's and an aircrew's flight toleration), Mike landed an almost zero write-up Habu back at Kadena after a flight lasting 11 hours and 12 minutes.

On 9 August, Majs Terry Pappas and John Manzi left Kadena in '975 and headed out for the first of several aerial refuellings. After clearing the first tanker, they climbed and accelerated towards Southeast Asia and then on south of India towards a second refuelling and their distant target area. Five hours after take-off they neared the collection area in the Persian Gulf. Everything worked exactly as planned, and soon they were heading eastbound on their long trip back to Kadena. It had not been a simple, straightforward mission by any stretch of the imagination. However, bad weather during two of the refuellings and a boom malfunction dictated that Terry had to maintain his contact position with the tankers for 3½ hours during the mission.

ASIA
Statute Miles
Railways
PEOPLE'S REPUBLIC OF CHINA
INDIAN OCEAN
PACIFIC OCEAN

When Majors 'Mac' McKendree and his RSO Randy Shelhorse flew their Giant Express mission on 26 October 1987, Mac carried this map in his pressure suit leg pocket… just in case. (Mac McKendree)

To make matters worse, nine hours into the sortie he became temporarily blinded by the combined effects of pure oxygen and an overheat condition that affected his moon suit's faceplate. The simple task of reading his instruments appeared almost impossible without opening his helmet visor, but such action was out of the question due to the dangers of decompression and hypoxia. Terry recalls that by squinting hard he could produce tears. That small amount of moisture revived his vision enough to continue the long mission. He completed the sortie with a smooth night landing back at Kadena after flying for more than 11 hours.

Later in the summer of 1987, US intelligence believed that the Iranians had acquired a consignment of land-based HY-2 'Silkworm' anti-ship missiles from China. The weapon had a maximum range of about 60 miles and employed active radar homing to locate its target. In September 1987, the Iranians began launching the weapons from the Al Faw peninsula at Kuwaiti oil terminals around 50 miles away. Initially the weapons missed their targets and fell on uninhabited parts of the coastline, but on 22 October a Silkworm slammed into a Kuwaiti oil loading facility at Sea Island; its 1,100lb warhead caused extensive damage and triggered a major fire. Just four days after this attack, Majs Warren McKendree and Randy Shelhorse completed their first Gulf sortie, in aircraft '967.

Using surveillance information gathered from these flights and by satellite, US intelligence was able to determine the most likely positions from where future deployment of the Iranian 'Silkworms' could threaten the Kuwaiti oil terminals. A brilliant civil servant and expert in decoys from the Naval Research Laboratory in Washington devised a simple and cost-effective solution to the problem by placing large corner reflectors on barges. Using the available imagery, these barges were then anchored between the likely launch sites and the potential targets.

On 7 December the Iranians launched a 'Silkworm' against a Kuwaiti oil-pumping station. The decoy worked as planned. The missile struck one of the barge-mounted reflectors, its short fuse delay detonating the warhead and blowing the unit off the barge. The missile's target was completely unscathed, no one was injured in the attack and no further 'Silkworms' were launched against the oil terminals.

Majors Dan House and Blair Bozek completed the last of these long-duration, high-priority missions in aircraft '974 on 30 April 1988. In addition to revealing the presence of Iranian 'Silkworms', the sorties also gathered extensive intelligence about the masses of military equipment in the Gulf. Thus, intelligence services were able to forewarn the US Navy of the missile threat, and diplomats were able to bring pressure to bear on Iran. The SR-71 had again performed its intelligence-gathering service in a distant part of the world.

In earlier times, the crews would surely have received Distinguished Flying Crosses for these unique and important missions, but the sorties were being flown at the time when the Air Force's Chief of Staff and other key SR-71 detractors were undermining the Senior Crown programme's achievements on the basis of costs versus benefit arguments. The last thing they wanted were 'Habu Heroes'. Therefore, the crews were only awarded Air Medals.

THE LAST HABU LOSS

The Spratly Islands are a collection of islands and associated 'maritime features' (reefs etc) that are important for economic and strategic reasons. The area holds potentially significant reserves of oil and natural gas and it's a productive area for world fishing. It straddles one of the busiest commercial shipping areas in the South China Sea, which makes it very important strategically.

Its 'ownership' is disputed between China, the Philippines, Taiwan, Malaysia, Vietnam, and Brunei. However, in 1987, the People's Republic of China (PRC) began deploying troops to some of the unoccupied reefs of the Spratly Islands. Then in March 1988, the People's Liberation Army (PLA) of Vietnam stormed the Johnson South Reef. Skirmishes broke out between the two opposing landing parties, prompting China to move quickly to consolidate its presence. By the end of 1988, the PRC had occupied six reefs and atolls in the Spratly Islands and taken a number of PLA prisoners. Thus, the Spratly Islands became an 'area of interest' to the United States government.

On 21 April 1989, the Stan/Eval crew, Lt Col Dan House and his RSO Maj Blair Bozek, were tasked to complete surveillance of the Spratly Islands via route GS 1057 (Giant Scale 1057), before returning back to Kadena along the Vietnam coast. The so-called 'rocket ride' departure entailed a direct climb to Mach 3 cruise enroute to their first air refuelling track, west of the Philippines.

At 08:47am (L), they completed the engine start procedure of '974, in readiness for a radio silent launch. Eighteen minutes later, the Habu – callsign Kobe 25 – slowly taxied from its barn behind the mobile vehicle – callsign Kobe 26 – manned by the Det 1 commander Col Lee Shelton and his Ops Director Lt Col Tom 'Bergie' Bergam. Enroute to the hammerhead the mobile crew completed a FOD (Foreign Object Damage) check. The crew then undertook an engine run-up check, which was normal. The proceedings were briefly interrupted by a heavy downpour that momentarily reduced visibility down to a mile. Contacting the control tower on his FM radio, the Det commander ascertained that the departure leg was clear of thunderstorms and at 09:23am the tower signalled to mobile and Kobe 25 that they were cleared onto Runway 23. Mobile continued down the runway to mid-field, performing a FOD check. Then, at 09:28am the tower used a green light to clear Kobe 25 for take-off and exactly two minutes later Dan released the brakes and engaged full afterburner. After lift-off, with both engines operating normally, Kobe 25 was accelerated to 400 KEAS and continued the climb-out and departure in accordance with the Standard Instrument Departure (SID). Maintaining Mach 0.9 and at 30,000ft, Dan completed the 'dipsy' push-over manoeuvre, established a climb to maintain 450 KEAS and engaged the auto-pilot 'KEAS HOLD' function. Between 30–37,000ft the crew experienced light turbulence and rain, but once above 37,000ft, the weather was clear and both inlets were operating normally. The engines continued to function as prescribed during the Inlet Guide Vane (IGV) shift point at Mach 2.1. Dan continued to monitor the inlet scheduling and the compressor inlet pressures and again, these were normal throughout the climb and acceleration.

Approaching their second enroute Destination Point (DP-2), '974's aircraft navigation system sequenced and the autopilot turned the aircraft to DP-3. At this point, a fuel check indicated that the aircraft was 2,500lb low, but given the prevailing atmospheric conditions, this was well within the expected fuel state. Eighteen minutes after take-off, Kobe 25 was levelled off at approximately 73,000ft and Mach 3. At this point, Dan gradually retarded the throttles from maximum afterburner, disengaged the 'KEAS HOLD' function and brought the power back to minimum afterburner for Mach 3 cruise. Level-off checks were accomplished and both inlets and engines were checked and indicated normal.

At about 09:50am, whilst about 81 miles short of DP-3, Blair began ranging (distance measuring), with Kobe 14 and Kobe 18 – the two supporting KC-135Q tankers. At about 40 miles from DP-3, the crew felt a sudden yaw to the left, accompanied by a noise similar to a mild unstart or compressor stall. Blair asked, 'Is that an unstart?' To which Dan replied, 'I don't know'. However, almost immediately afterwards, their situation deteriorated and Dan was forced to react with the appropriate 'Boldface Procedures', to ensure that the aircraft remained within its angle-of-attack limits; the checks were verbally backed up by Blair. However, on checking his engine instruments, Dan discovered that the left engine RPM had dropped close to zero, and informed Blair that the left engine had flamed out and he was retarding the left throttle to idle. Several warning and caution lights illuminated on the annunciator panel and '974 was exhibiting a pronounced yawing movement to the left. Another check of the left engine revealed the following, RPM 0: EGT:134°, Nozzle Position: 50 per cent, fuel flow: 15,000lb per hour: Oil pressure: 0psi: Left Utility Hydraulic (L) Pressure: 0psi, Left Flight Hydraulic (A) Pressure 0psi. Dan then moved the left throttle to the cut-off position and the right throttle to minimum afterburner, and confirmed with Blair that the left engine had been shut down. All these Boldface actions were then reviewed by the crew.

Back at Det 1, Mac and Randy enjoy a well-deserved glass of fizz with Det commander Col Lee Shelton. (Mac McKendree)

MiG-31s stationed in the Soviet Union's Far East were not uncommon sights to Habu crews flying off Vladivostok and Petropavlovsk. (Yefim Gordon)

The aircraft's heading at the time of engine failure was 229°, but this had slowly veered left to 212°, due to the asymmetric thrust condition it was now experiencing. Within two minutes of the engine failure, the aircraft had deviated 10 miles left of its prescribed track. This was again due to asymmetric thrust and control issues relating to the yaw and roll oscillations. One minute after the engine failure, the aircraft was at Mach 2.85 and descending through 68,000ft. No unstarts were experienced except in the left inlet during the initial engine failure, at which point the left forward by-pass door moved forward and remained at the full-open position. To add to Dan's woes, one minute and forty-two seconds after engine shutdown, the remaining aircraft yaw SAS (Stability Argumentation System) channel disengaged, providing him with no yaw stability assistance. This was immediately followed by a series of extreme roll attitudes in excess of plus or minus 50°, with accompanying yaw and pitch excursions. It was during these extreme oscillations that the right inlet experienced an unstart, causing it to briefly position itself to the inlet restart configuration – increasing the severity of the oscillations.

Dan recalls,

> It felt like we were experiencing a series of falling-leaf manoeuvres. We were 'wrapping up' from one side to the other. I was ramming the stick through full-throw, back and forth, as quickly as I could, but the aeroplane was doing pretty much what it wanted. That got me quite excited because from Mach 3 to Mach 2.5 I felt that I had no control whatsoever. I was most concerned because I didn't understand its cause.

Monitoring speed and altitude from his position, Blair made several speed and altitude calls to Dan – at one point the aircraft reached a maximum of 489 KEAS. Control of the aircraft was maintained by using half full stick and rudder travel to the right, reducing speed by increasing the pitch attitude of two or three degrees. Once the oscillations had stabilized, Blair continued calling through the emergency checklist actions.

Four minutes after engine shut-down '974 was at Mach 2.05 and passing through 59,000ft. Blair entered the Clark AB coordinates into the ANS for steering information and reviewed the Mach 2.0 checks. Dan then turned left to a heading of 190°. Now four minutes and twenty seconds after shutdown, Blair switched the IFF to Emergency, and continued with the checklist as Dan eased the right throttle out of Min A/B to Mil power. Five minutes thirty seconds after engine failure, cross - checks were accomplished and the aircraft was at Mach 1.7 and 49,000ft and Blair confirmed the course to Clark AB. One minute later, at Mach 1.3 and 45,000ft, the crew discussed fuel requirements to reach Clark, 283 miles away and concluded they had more than sufficient. With 270 miles to run and at Mach 1 and 33,000ft, the remaining (B) flight control hydraulic system quantity low light illuminated. They checked the pressure, which was normal. Blair reviewed the A and B Hydraulic System Checklist – it called for ejection! He then went back to the engine failure and descent checklist items, established UHF radio contact with the tankers Kobe 14 and 18, informed them of the problem and directed them to proceed to Clark AB.

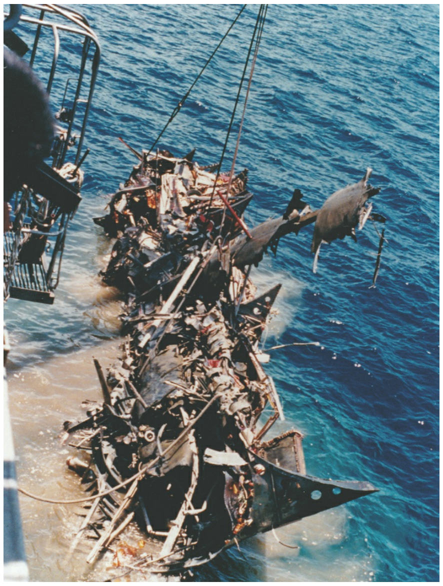
Now fourteen minutes after engine failure, Kobe 25 was just 25 miles from the northern coast of the Philippines and inbound to Clark AB. Blair had just finished transmitting the HF abort message to Kadena, when Dan informed him that Hydraulic Pressure B was fluctuating from 3,000 to 2,000psi. They discussed an immediate landing at any available strip when Dan's attention was grabbed by two one-foot diameter holes on top of the left engine nacelle!

Sixteen minutes had now elapsed since the engine failure and Kobe 25 was maintaining 340 KEAS and 11,000ft. The hydraulic pressure continued to fluctuate and decreased below 2,000psi. With high terrain ahead, the crew discussed the merits between abandoning the aircraft over water or land. About two miles from the coast, Dan turned '974 left and rolled out heading 095° parallel to the coast, maintaining 340 KEAS and 8,400ft. Dan now reported to Blair that the 'Hydro B' had dropped to 500psi.

Thirty seconds later Hydro B dropped to zero and Kobe 25 began to roll right at a rate of five degrees per second. Unable to control the aircraft, Dan gave the command to eject as the aircraft continued to roll right and pitch up. Blair was forced forward and downward as '974 departed controlled flight. Dan ejected about one second later. Blair fought to regain ejection position, ejecting three seconds after the pilot, at which point the aircraft was between 10–20° nose high and in a 40–70° right bank. The aircraft then entered a series of rapid gyrations around all three axes before stabilizing in a flat inverted position, before impacting the water about a mile from the shore. Dan describes the rest of the incident:

Majors Dan House and RSO Blair Bozek (left) attend a crew briefing. Their planned mission GS-1057, to monitor the Spratley Islands and the coast of Vietnam, didn't run according to plan and they were forced to eject off the Philippines. (Blair Bozek)

Central to recovering the wreckage of '974 was (ATS-2) USS *Beaufort*, an Edenton-class salvage and rescue ship of the US Navy. (USAF)



'974's fuselage forebody breaks the surface. (USAF)

I checked the 'chute, which was fine, and then started looking for Blair, whom I could not immediately spot. It seems he'd gone out after me because he wasn't in the correct sitting position for a safe bailout. Therefore, he was ahead and above me. When I finally located him, I started looking for '974, which was under me, falling straight down in planform. It happened to be upside-down and was not pitching or tumbling. As she hit the water, there was a splash and a brief fireball. Then all was gone.

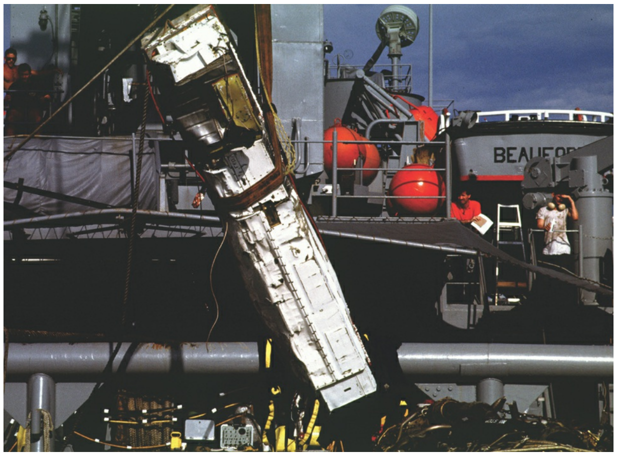
I readied myself for a feet-wet landing. My descent rate under that 35ft-wide canopy was very slow, so I had plenty of time to look around. It was a sunny morning, there was no wind, the vegetation on the island was lush and green, and the calm blue ocean I was about to enter was flat, with no waves. I could see fishing boats turn toward me and by the time I'd cleared my 'chute, a Bonka boat had arrived next to my position in the water. A Bonka boat is a 20ft dugout canoe with outriggers on either side and powered by the noisiest internally-mounted two-stroke engine I have ever heard in my life.

Two Filipino fishermen offered to lift me into their boat, and since one of my life rules was to never give up a free ride when you're shark bait, I gladly accepted. They retrieved all my life-support gear and lifted the parachute aboard their little boat and then we went over to where Blair was waiting. He'd gotten into his life raft and was just climbing into another Bonka boat that had raced toward him as he descended. He tried the survival radio but couldn't hear anything because the search and rescue forces were still too far away. We went to the scene of the aeroplane's impact where there were only a few pieces of debris and some fuel floating nearby.

We then asked the Filipino fishermen to take us ashore. They told us that the area opposite was controlled by the New People's Army (communist insurgents who occupied the island), so they took us instead to a town that was a two-hour ride to the east. After they handed us over to an officious policeman who was a member of the local militia, we tried to call Clark AB, but no one knew the phone number. Next, we asked to talk to the US consulate in Manila, but we had to wait our turn behind about 30 other people waiting to use the one phone. They eventually decided to take us to some local officials who could certainly help us. We'd taken our pressure suits off and were wearing the dark green nylon lining over our long underwear.

We entered a large building carrying our survival gear and parachutes and were introduced to the mayor and town council. They were very concerned for our well-being and asked if we needed to see a doctor. When we told them that it wasn't necessary, they invited us to have lunch with them. We had a wonderful meal of rice, pork, vegetables and pickled squid, plus the best ice-cold bottles of Coca-Cola we'd had in our lives. The mayor then insisted that we take coffee with him at his home.

While our survival radios were sending out their radiant signals, 'come save us, come save us,' we were enjoying coffee on the mayor's lawn! We had asked if there was a radio transmitter anywhere. Eventually they agreed to take us to one. As we were enroute, a Lockheed P-3 Orion flew overhead. We stopped the truck and made contact, but our radio reception was not very good. On reaching the short-wave radio, we identified ourselves to the Orion crew and were told that a helicopter was on its way to pick us up. We drove back to the mayor's house and Blair positioned himself in a dried-up rice field to greet the helicopter's crew. Meanwhile, I went back to the mayor's house for a final cup of coffee and to thank him and his countrymen for their wonderful hospitality. I also picked up our mission gear, which we'd left on the patio.



A TEOC is crained onto *Beaufort*'s stern. (USAF)

The HH-53 Super Jolly Green Giant took us back to Clark Air Force Base. The crew was superb and wanted to take us to the 'O' club for a few 'coolers', but post-accident rules dictated that they had

> to hand us over to the medics for a physical examination. After this rather wild five-hour adventure, we were strapped to a stretcher by four medical corpsmen who put us in an ambulance. I had not been so helpless since ’974 underwent the falling-leaf gyrations. Once we were in the ambulance, the doors were closed and the driver backed up no more than a hundred feet before the doors were flung open once again and they carried us into the hospital. Other than our bad attitudes for their seemingly stupid procedures, they found nothing wrong with us and after 24 hours of ‘observation’ they released us.

Side-scanning sonar imaging of the crash site took place on 29 and 30 April, and it was not long before the debris field of ’974 was located. The 280ft-long salvage vessel USS *Beaufort* was dispatched to lift the wreckage with its 10- and 15-ton cranes, fitted on the bow and stern, respectively, and to find the sensors and defensive systems (Coincidently the ship was built by Brooke Marine, in the author’s home town of Lowestoft, Suffolk). Due to the proximity of the communist New People’s Army, a number of Navy SEALs were on board to provide protection to the divers and crew.

One morning during the search an order for General Quarters was sounded at 0400 hours. Crewmen rushed to their action stations in readiness for an immediate confrontation. They saw a large number of small vessels (which had been detected on the *Beaufort*’s radar) making for the ship. Tension mounted until it was discovered that the would-be attackers were fishing boats that had come towards the bright lights of the naval vessel because a very large school of fish had congregated around it.

When ’974 impacted the water inverted both engines, the main undercarriage and the aircraft’s sensors smashed through its upper surfaces. They were scattered on the ocean floor at varying distances away from the main wreckage field. On the evening of 1 May, wire hawsers were attached to one of the J58 engines. The late evening movements dislodged the TEB tank and caused a small leak, which released tiny amounts of the chemical throughout the night. As the volatile chemical bubbled to the surface, it mixed with ambient air and exploded in small green puffs. The ‘magic’ of the ‘Yankee’ engineers caused quite a stir among the native fishermen who saw the eerie ‘TEB-bubble show’.

The next day both engines were lifted and brought aboard the *Beaufort*’s fantail, and two days later many of the sensors were also recovered. When the ship’s crew attempted to lift the main section of the aircraft, the crane operator found that the large delta-shaped wing planform greatly exceeded the lifting capacity of his crane, and the wreckage refused to budge an inch. A yard derrick was sent from Subic Bay and the forward fuselage section was recovered on 7 May, while the main structure was lifted aboard the *Beaufort*'s fantail the following day. The black wreckage was a sad end for a once-proud aeroplane, despite Dan's skilful and valiant efforts to save it.

POST SCRIPT

Having reclaimed the majority of '974 from a depth of 120ft, the Mishap Board tasked with identifying the cause of the incident benefited from the recovery of the aircraft's Mission Recorder System tape box (the MRS records almost all engine and hydraulic systems and the cockpit conversations). All data held on the system was retrieved and found to be in excellent condition. The board were extremely impressed by the crew's professionalism and their adherence to checklist procedures, in addition they were interested in the crew's report of noting holes in the left engine nacelle. During an inspection of the wreckage, other holes were discovered in the nacelle radiating from the area near the compressor section of the left engine. Several hydraulic lines, later identified as both A and B system lines were found to be still in place. Damage patterns indicated that the lines had been cut by engine shrapnel, before being severed when the engine was torn from the nacelle on impact with the ocean. Remarkably, one section of the B pressure line, was found to have foreign damage. Closer inspection revealed that this was also the location of a crack. The foreign material responsible for the crack was found to have come from a compressor blade. It was calculated that this crack would have allowed hydraulic fluid to slowly escape at a rate that was compatible with the loss of the hydraulic, B system pressure. Both J58s were recovered and the left engine, serial 314K, was sufficiently intact for the board to find holes in the compressor case, one to two inches in size, surrounded by outward facing, peeled back metal. This suggested that the compressor blades had been violently thrown out of the engine case, directly into and through the engine nacelle. Analysis by Pratt & Whitney specialists established that the site of the engine failure centred around the sixth stage of the compressor. The sixth stage blades had been 'liberated' from the rim of the disk, initially towards the front of the engine (due to air-loading generated by the compressor), after which, damage was inflicted aft (due to airflow through the engine). As there's very little clearance between each set of stationary stator blades and rotor vanes, any movement fore or aft causes significant impact damage. Therefore, when the sixth stage compressor blades stuck the trailing edges of the fifth stage vanes, having been shed from the disk rim, were blasted aft into the sixth stage vanes, then the seventh stage blades followed by the seventh stage vanes etc. During this disintegration process, some of the loose debris lodged inboard of the disks and this caused the rim segments to escape beyond the confines of the engine casing, producing holes in the upper portion of the left nacelle, as reported by the crew. It was calculated that the entire event from initial failure to engine seizure took between 3-6 seconds – as evidenced from the fact that there were no metal splinters in the burner or turbine sections, which is usually the case where failure is the result of FOD. It was thought that the engine stopped rapidly due to a disk rim section, jamming into the inboard side of an external component like the Accessory Drive Gearbox. The engine was sent for tear-down, during which it was quickly discovered that the disintegration process had started in the number two bearing compartment. Further examination showed that the most probable cause was either debris in the oil, or a manufacturing flaw. This had caused the spalling of the ball bearing and ultimately, failure of the bearing cage, that led to the progressive destruction of other major engine components, including the cutting of unprotected flight control hydraulic lines that surrounded the engine compressor section.

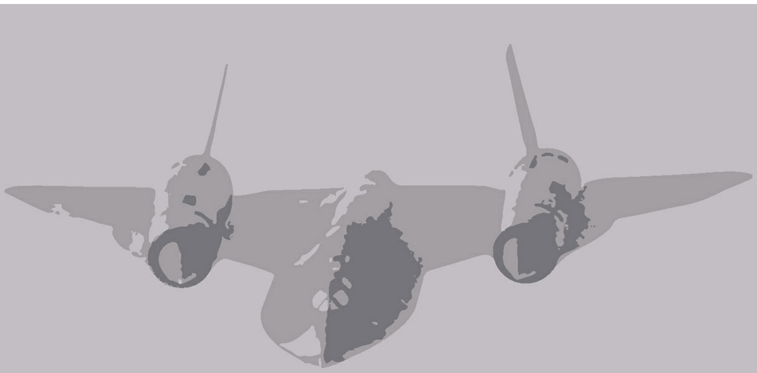
The ‘Mishap Board’ recommended that soap samples should be taken after each flight, that a study should be undertaken to determine the feasibility of protecting both A and B system flight control hydraulic lines from shrapnel and finally that a representative sample size of the failed bearing lot determine if spalling or manufacturing defects exist.

On 12 August 1988, Majors Rod Dyckman and his RSO John Manzi had ferried ’979 back to Beale, leaving Det 1 with just one SR-71, ’974. It wasn’t replaced until 9 June 1989, when Majors Mac McKendree and his RSO Randy Shelhorse ferried in ’962. The Det had therefore been without an aircraft for nearly two months. It was very much a sign of the times as to how the programme was now viewed through the lens of ‘the fighter mafia,’ that now held key positions at the Pentagon and were manoeuvring to kill off the Senior Crown programme for good.

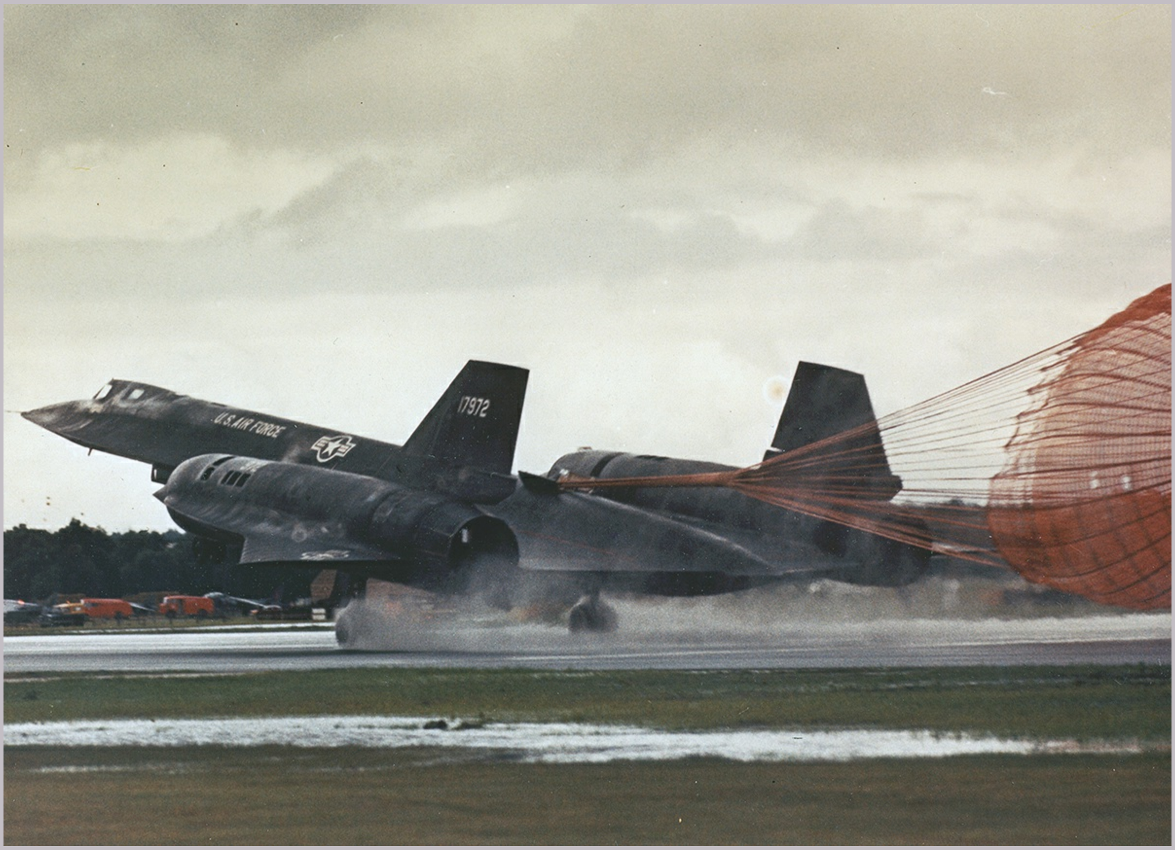
The inevitable happened on 22 November 1989, when all SR-71 flights were suspended except for minimum proficiency flights. A month later on 22

December the programme was officially terminated.

’974 hit the water inverted, causing the engines and heavy undercarriage to smash through its upper surfaces. (USAF)



CHAPTER 15:
DET 4 THE EARLY YEARS



‘972 touches down at a wet RAE Farnborough on 1 September 1974, claiming in the process a new world speed record from New York to London of just 1hr 54mins and 56secs. It was also the first SR-71 to visit the UK. (Lockheed Martin via Tony Landis)

GIANT REACH

Giant Reach was SAC’s codename for SR-71 European-based contingency planning of photo and ELINT reconnaissance-gathering operations. The original plan was to split this coverage and conduct both PHOTINT and ELINT of the Middle East and purely ELINT of Eastern Europe due to weather conditions, usually hostile to the collection of photographic imagery in northern latitudes. In order to execute these preliminary proposals, first published by HQ SAC on 6 April 1970, it was envisaged that five KC-135Qs would be deployed to Incirlik AB, Turkey and an SR-71 together with three 135s, and support personnel would be assigned to Torrejón AB, Spain, on a 30-day temporary duty (TDY) basis. However, the Spanish prohibited overt reconnaissance flights from originating from or recovering into their country, so that element of the proposal was modified and instead the SR-71 would be based at RAF Mildenhall, England.

During these early planning stages, it was thought that the SR-71 would conduct between six to eight sorties during each deployment and the photoproduct would be processed by the 497 RTG at Shierstein, West Germany, while the ELINT and HRR ‘take’ would be ferried back to Beale and analysed by the 9th RTS. However, additional funds to support such operations weren’t initially available. Despite this, HQ USAF directed SAC to spend $50,000 from its operation and maintenance budget on alterations to the apron adjacent to hangar 538 at Mildenhall as a precautionary measure, in case the JCS directed that such sorties should go ahead; this construction work was completed in 1971.

The first operational requirement for European-based SR-71 sorties occurred on 6 October 1973 with the outbreak of the Yom Kippur War, but as covered in Chapter 12, the plan wasn’t implemented. As a consequence, it was not until 1 September 1974 that the first Habu visited England. On that historic day, Majs Jim Sullivan and his RSO Noel Widdifield, flying SR-71 number ’972, established a transatlantic world speed record from New York to London of less than 2 hours, a record that stands to this day (see Appendix 11 for further details). Thirteen days later, Capt ‘Buck’ Adams and Maj Bill Machorek set a return trip record to Los Angeles in the same aircraft of less than four hours.

To underline the partnership status of any future SR-71 deployments to the United Kingdom, Secretary of State Henry Kissinger instructed Mrs Anne Armstrong, the US Ambassador to Britain, to inform Her Majesty's Government that the US 'would of course be prepared to share with the British information produced by [such] SR-71 missions'.

Detailed route planning for any future SR-71 deployments to the UK was conducted by the Strategic Reconnaissance Center. They then sent details of three proposed tracks to the 98th Strategic Wing (SW) at Torrejón, Spain, as this unit was responsible for SAC operations from Mildenhall. Detachment 1 of the 98th SW, stationed at the UK base, then coordinated all necessary prior actions and notifications with the appropriate British officials.

ON THE GROUND

Expansion of Soviet ground and naval forces had a profound influence on future SR-71 operations within Europe. On the ground, Soviet and Warsaw Pact armed forces lacked the training and technologically advanced weaponry of NATO. Their advantage lay in overwhelmingly superior numbers concentrated into large numbers of armour, artillery and mechanized infantry divisions on a small number of narrow fronts that would drive deep into western Europe. American military planners doubted the ability of early NATO doctrine to stop such an offensive without the employment of tactical nuclear weapons, which in turn could easily escalate into a full-scale nuclear conflagration that could devastate not just Europe but the world.

The US experience in Vietnam indicated that attrition tactics were unable to achieve decisive results, at least in a politically acceptable timeframe, with politically acceptable losses. Rather than fighting while outnumbered and winning, a new concept emerged aimed at controlling the larger 'battle space' in order to reduce the strength and effectiveness of enemy forces prior to the moment of main contact between opposing ground forces. This called for interdicting the adversary's flow of men, materiel and supplies by using aerial assets, long-range artillery, and air mobility. By immediately taking the fight deep into the enemy's rear area, NATO could channel the attackers' movement, drive gaps into their formations, and deny follow-on echelons from joining the battle. This, it was anticipated, would disrupt both the enemy's momentum and its combat effectiveness, which in turn would force a 'culminating battle' in which NATO could manoeuvre to decisively counter-attack whatever had by then been identified as the enemy centre of gravity, thereby gaining the final decision.

Thus developed the US Army's so-called Air Land Battle strategy, which had four doctrinal tenets: initiative, depth, agility and synchronization. To execute these principles, corps-level units were required to become the primary command communications (C2) headquarters, involved in both operational-level engagements and conducting the deeper attacks on enemy formations massing for combat up to 100 miles away by synchronizing artillery assets with air power. The overall battle space was partitioned into the Close Battle Area (up to 13 miles beyond the Forward Line of Own Troops or FLOT), the Deep Battle Area (which might extend to 120 or more miles beyond the FLOT), and the even more distant Strategic Battle Area.

The new army doctrine was aligned with close air support (CAS) concepts the US Air Force wanted to apply to its own evolving concept of deep battle. The Air Force had long resisted the reduction of airpower to the status of flying artillery, preferring instead to operate against strategic and other targets beyond the battlefield. Nonetheless, a close working partnership developed between the two services in forging the new doctrine. The SR-71's ability to execute highly effective Peacetime Aerial Reconnaissance Program missions (PARPRO) at extreme altitudes from within allied or international airspace, thereby acquiring vital reconnaissance data from deep inside Soviet borders, was key to US planners, as was the ongoing monitoring of Soviet/Warsaw Pact activity, particularly during the twice-yearly (autumn and spring) troop rotations.

Still holders of the New York to London speed record, Majors Jim Sullivan and Noel Widdifield. (USAF)

On 20 April 1976, two KC-135Qs and the same SR-71 that established the transatlantic speed records – aircraft ’972 – returned once again to the UK, but this time the trip was made without the attendant media coverage that accompanied its earlier visit. Using the callsign ‘Burns 31’, Maj ‘Pat’ Bledsoe and Maj John Fuller completed the flight from Beale to RAF Mildenhall in 4 hours 42 minutes. The key objectives of this deployment were for the aircraft to complete two training sorties; the first was to be flown over both the North Sea and Norwegian Sea and a second conducted over the English Channel and Bay of Biscay. These flights would both exercise the aircraft’s base support facilities and help to shape the aircraft’s flight profile and operating procedures that would need to be adopted for flying within the cramped airspace of Northern Europe. These actions would pave the way for future SR-71 participation in NATO training exercises, the first of which was scheduled for later that same year.

Three days after its arrival, the first evaluation sortie got under way when Capt Maury Rosenberg and Capt Don Bulloch engaged both burners and departed the base. However, when they were to the west of Norway at 72,000ft, Bulloch discovered that the outside air temperature was 30° warmer than anticipated. After quickly recalculating the aircraft’s performance values in this sub-Arctic environment by cross-correlating exhaust gas temperature (EGT) against inlet door position and interpolating the aircraft's true airspeed from the astro-inertial navigation system, the crew were alarmed to learn that their computed fuel specifics were way off the mark, and their actual fuel burn considerably higher than that calculated by the nav-planners back at Mildenhall. In fact, '972 was going to be 8,000lb lighter than planned by the time they arrived at their air refuelling control point (ARCP), which in turn meant that they would barely be able to reach their tankers. The crew prudently decided to abort the mission and return to Mildenhall. The second training sortie was completed by Bledsoe and Fuller on 28 April, and two days later, using the callsign Kabab 31, Rosenberg and Bulloch returned '972 to Beale.

Two large NATO exercises kicked off in the autumn, Cold Fire '76, a land and air operation running from 7–10 September conducted in West Germany, and Teamwork '76, a land, sea and air exercise to be held in the North and Norwegian seas from 10–23 September. Headquarters European Command were keen that the SR-71 should participate in both exercises, pointing out that not only would this provide valuable training and logistical experience, but that it would also demonstrate 'positive US resolve in support of NATO'. Such participation would of course require authorization from several command authorities as well as the UK Ministry of Defence (MoD), the JCS, United States Air Forces Europe (USAFE) and NATO member nations. Luckily negotiations to obtain prior approval for the SR-71 to overfly NATO countries and enter their airspace began early. As it turned out, the process was far from straightforward and took several months to complete – Denmark took it right to the wire and was the final country to grant its approval in early September.

Due to a technical malfunction, Capt Harold Adams and RSO Maj William Machorek left Mildenhall a day later than planned, returning '972 back to Beale on 13 September 1974. (Bob Archer)

The deployment of '962 began on 2 September 1976, but Al Cirino and his RSO Bruce Liebman had to divert into Goose AB, Labrador following engine trouble over the central United States. An emergency maintenance team was dispatched from Beale and the flight to Mildenhall was completed by Al and Bruce four days later. Majors Rich Graham and Don Emmons flew the following day in support of Teamwork '76 and incorporated lessons learned from the previous deployment; they successfully completed the first operational mission over the Barents Sea before recovering safely back to 'The Hall'. Then it was Al and Bruce's turn. They were tasked to fly into West Germany in support of Cold Fire '76, which again they successfully completed in '962. In total six sorties were flown and HRR imagery, photography and ELINT was collected from the exercise areas before Rich and Don returned the aircraft home after a European tour lasting 19 days.

Before the next Habu deployment to the UK, a change in SAC's European reporting structure took place following Senate ratification of a new treaty with the Spanish government in January 1976, which stipulated a reduced American military presence in that country. Consequently, on 31 December 1976 the 98th SW was deactivated. Command was transferred to the 306th Strategic Wing, which had been activated four months earlier and co-located with Headquarters USAFE at Ramstein AB, Germany. General Richard Ellis, Commander in Chief USAFE, and CINCSAC Gen Russell Dougherty, whom

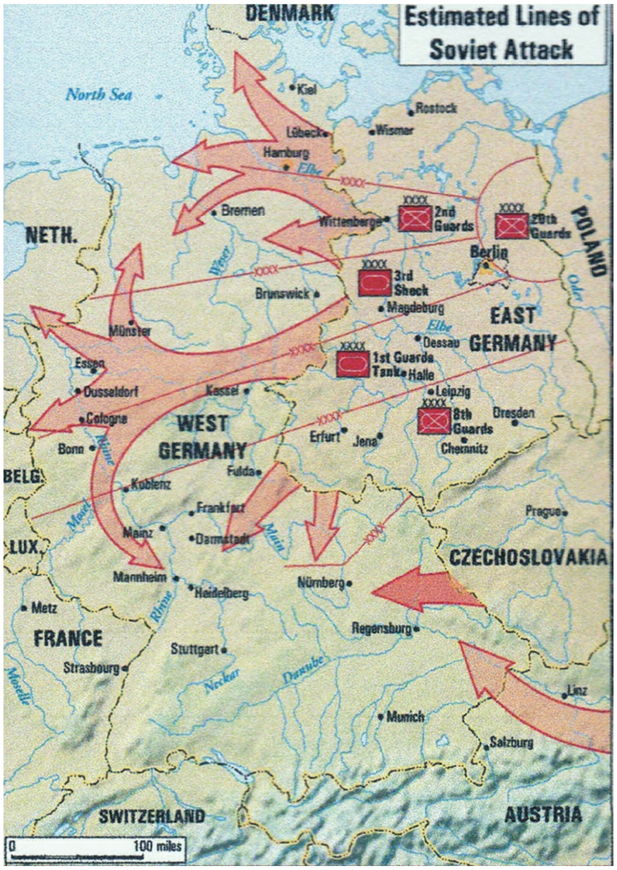
Gen Ellis succeeded as the SAC Commander on 1 August 1977, had had extensive discussions in the months leading to this command restructure and had formulated a plan that would have a profound impact on the build-up of SAC assets in Europe.

It had been decided that the 306th SW commander would report directly to the CINCSAC and his staff, and that he had 'delegated authority' to exercise the CINCSAC's command responsibilities for all present and future SAC European operations. These related to the European Tanker Force, the RC-135s that were TDY with the 306th SW's detachments at Mildenhall and Hellenikon AB, Greece, as well as any future B-52 or U-2R/SR-71 deployments.

The desire to increase SAC's presence in Europe had its roots in the changing nature of the Soviet/Warsaw Pact threat facing NATO. General Ellis wanted B-52s to deploy periodically to England, together with their support tankers, in order to train such a force to a level that was capable of performing a wartime tactical mission: this, he envisaged, would consist of interdiction both in the vicinity of the battle area and beyond its forward edge, as well as airfield attack, defence suppression, sea surveillance and anti-shipping. It followed, therefore, that if B-52s were tasked to perform a mission similar in nature to that which they had flown for eight years in Southeast Asia, the U-2R and SR-71 would again be required to provide complementary pre-strike and bomb damage assessment imagery in addition to SIGINT warning information. An additional issue of particular concern to Gen Ellis was the unprecedented level of sophistication that accompanied the twice-yearly Soviet-Warsaw Pact exercises that had begun on 31 December 1976. Specifically, he noted, 'Of particular interest to us at SAC is their coordinated and extensive use of airborne command posts as alternate command centres and their ability to control forces when required, particularly during/after a global nuclear exchange'. On balance therefore, it's perhaps not surprising that as far as the general was concerned, it was 'most desirous' that the SR-71 and U-2R deploy to RAF Mildenhall to monitor these exercises.

The third SR-71 training deployment was completed by serial '958, which arrived as Ring 21 on 7 January 1977: Rich Graham was again at the helm with Don Emmons 'in the back'. In support, two KC-135Qs transported 65 maintenance, operations and logistics specialists, together with 80,000lb of equipment. Col John Storrie, the 9th SRW commander, also accompanied the deployment to inspect for himself Mildenhall's support facilities. This 10-day deployment was timed to coincide with the approximate date of President Jimmy Carter's inauguration, and it would thereby underline the United States' continued support of its NATO allies. Two training sorties were again flown by the SR-71, covering the same sea areas as the April 1976 deployment. Maj Tom Alison and his RSO Maj J. T. Vida made up the second SR crew on this deployment, and it was they who repositioned the aircraft back to Beale as Paver 86.

In late February 1977, Headquarters SAC recommended to the JCS that they seek approval for another SR-71 operational deployment to Europe. It was proposed that the 17-day tour should consist of one training sortie, similar to the two completed in January 1977, and two PARPRO missions. The first of these would be a coordinated sortie with a Mildenhall-based RC-135V and flown along the Barents Sea periphery, while the second sortie would be flown over West Germany. SAC requested that both of the PARPRO missions be approved to collect ELINT and HRR imagery, since they were particularly anxious to demonstrate the unique characteristics of the latter to other potential national intelligence users. While the proposal navigated its way through the JCS evaluation process, the SRC worked on preparing the aircrafts' tracks in anticipation of receiving an affirmative for the deployment. The JCS duly issued SAC with the necessary authorization to proceed on 6 May 1977; they also instructed that the SR-71 was to adhere to tracks prepared earlier in the year by the SRC as these had been used by the State Department to coordinate and obtain the necessary clearances from five NATO nations through whose airspace the SR-71 would fly. The JCS also went on to direct Headquarters SAC to deploy to Mildenhall a Mobile Processing Center (MPC), held in storage at Beale. This last instruction was issued in response to a request from Gen Ellis, and as such had been anticipated by SAC.


Estimated Lines of Soviet Attack
DENMARK
North Sea
Kiel
Rostock
Lübeck
Wismar
Hamburg
Elbe
Bremen
Wittenberge
2nd Guards
20th Guards
POLAND
NETH.
Berlin
Oder
3rd Shock
Brunswick
Weser
Magdeburg
EAST GERMANY
Elbe
Dessau
Münster
1st Guards Tank
Halle
Essen
Dusseldorf
Kassel
Leipzig
Cologne
WEST GERMANY
8th Guards
Dresden
Bonn
Rhine
Erfurt
Jena
Chemnitz
BELG.
Fulda
Koblenz
Frankfurt
Prague
Mosel
LUX.
Mainz
Darmstadt
Main
CZECHOSLOVAKIA
Mannheim
Heidelberg
Nürnberg
Metz
Rhine
Regensburg
FRANCE
Stuttgart
Strasbourg
Neckar
Danube
Linz
Moselle
Munich
Salzburg
SWITZERLAND
AUSTRIA
0
100 miles

European Theatre of Operations map showing estimated lines of Soviet ground assault. (Osprey)

THE MPC

In 1977, two MPCs existed in addition to the one alluded to by the JCS, the other (MPC I), was in caretaker status at Kadena AB. Each MPC consisted of 24 trailer-like vans that measured 8ft x 8ft x 40ft and collectively contained all the equipment necessary to process raw intelligence data collected by the SR-71's HRR and cameras. (MPC I was also equipped with an Electromagnetic Reconnaissance (EMR) formatter that processed the ELINT tapes; however, at a cost of over a million dollars each (mid-1960s values), it had been decided that only one MPC would have this additional capability, and this was installed in the unit located at Kadena). The MPC could be deployed overseas in various tailored packages or van combinations to support different levels and types of reconnaissance operations. The complete package was designed to support one

SR-71 mission per day and required an operating staff of 60 officers, airmen and civilian contractors. Depending upon the amount of data collected, typically photography and HRR imagery was available to the interpreters four hours after the Habu had landed (MPC I also afforded top-line ELINT signals ready for first-stage analysis in about three hours). The entire 24-van package of MPC II destined for Mildenhall weighed in at 290,000lb and was transported to the UK in two C-5s and four C-141s: transportation costs were picked up by USAFE, but manpower and payment for expendable supplies came from SAC monies already allocated. On arrival in the UK, MPC II was located inside a secure compound within hangar 538, and at great credit to all involved the facility was operational when Indy 69, aircraft ’958, touched down at the UK base on 16 May 1977.

OPERATIONAL DEPLOYMENT TO THE UK

Buz Carpenter describes the positioning of Indy 69 to the UK:

> John Murphy, my RSO, and I had just completed our first tour overseas at Kadena AB, where we had flown our first operational SR-71 missions. This is where all crews first went after they had completed their year of training at Beale AFB and where you were closely supervised and guided through your first few missions, both training and then operational.
>
> Returning from Kadena we felt we were too junior to be eligible to deploy to England for these missions. Precedent had always been that the senior crews executed these missions from Europe or any other new locations; however, Col Willie Lawson, then director of operations for the 9th SRW, decided that in order to keep the SR-71 crew force balanced in experience and time away from home, he would allow newer crews who had completed their first Kadena tour to be in the pool to meet these new tasks.
>
> John and I were delighted and honoured as the most junior crew when we were told we would fly the SR-71 to Mildenhall and stay there for this deployment. We were both excited about this opportunity and most appreciative of the confidence Col Lawson had put in us.
>
> The mission to England was not any longer than any mission we had already flown with two refuellings. Differences lay in the arrival procedures for the SR-71 entering the United Kingdom and the airfield familiarity of Mildenhall itself. Because of English weather conditions we normally departed California at about 2:00am, which after two refuellings and two hot legs in the four-hour flight got you into England in the middle of the afternoon.
>
> These missions were supposed to be secret and had been coordinated through the special offices in each of the FAA regional centres we would fly through until entering Canadian airspace. Canadian air traffic centres provided this same level of special support. This idea was to protect our route of flight and also to keep our destination unknown. Secrecy was supposed to be a very important mission factor. We went into work the day before departure, as always, to plan the mission and to get everything checked out. Later in the afternoon, we each took a sleeping pill to ensure we got the

required crew rest. Around 11:00pm we awoke and headed to the Physiological Support Division for our pre-flight physical, to pick up our mission materials, have our pre-flight meal of steak and eggs and meet with the back-up mobile crew to determine the status of our aircraft. Suiting up started around one hour before take-off so that we could arrive at the aircraft about 45 minutes before our 2:00am take-off slot.

As I remember, everything went smoothly until I discovered that my helmet face heater was not working after I had been strapped into the aircraft, which caused my glass faceplate to completely fog over. Spares were normally available and a replacement helmet was quickly found and installed on my pressure suit. We then blasted off into the darkness at exactly the prescribed time of 2:00am. About 150 miles from Beale out over the Nevada desert we hooked up with our awaiting tankers at 25,000ft. During the refuelling we took on about 60,000lb of fuel and dropped off the tanker over Northern Utah and started our climb and accel. Passing through 60,000 we would routinely call the Air Traffic Centre as we turned off our electronic altitude reporting at this point. Salt Lake Centre said, 'Roger Indy 69, have a great time in jolly old England'. So much for mission security! We had not said anything, so we felt we would be exonerated. Cruise leg was uneventful as we passed over the northern United States and into Canadian airspace at Mach 3.0 and above 75,000ft. I remember it was a moonless night, which when flying over thinly populated areas gives you an opportunity to see a vast array of twinkling stars that you don't see on the ground because of their lack of intensity and the fact that the atmosphere filters them out.

As we approached the Canadian east coast near Goose Bay, Labrador, the sun was starting to rise as we were descending and decelerating. This particular condition was wonderful to view from 75,000ft, yet it was one of the most difficult refuellings, because as you were under the tanker at 25,000ft, trying to maintain your position and monitor the tanker refuelling director lights on the belly of the aircraft, the sun was just above the horizon and right in your eyes. It blinded you, even with your helmet sun visor down. With the refuelling done, we then separated from the tanker again and started our climb and acceleration eastward over the Atlantic and on into Scotland. As we crossed, Greenland was partly visible and a couple of huge icebergs were seen slowly floating south. Iceland was completely shrouded in clouds, as usual, and the weather in England was going to be overcast and rainy.

Our descent and deceleration were normal and brought us over England subsonic, and we proceeded south and east to Mildenhall. About 50 miles out we made contact with our mobile crew for recovery, Tom Alison and J. T. Vida. They advised us of the weather and to look for the birdwatchers. Initially John and I were puzzled by the birdwatchers remark. As it turns out, about half an hour before our arrival, a couple of hundred aircraft birdwatchers showed up with their cameras to photograph our arrival! Again, so much for security involving our flight over. The birdwatcher net sure trumped our security plan.

Arrival was uneventful and after a precision approach I chose to take the aircraft around for one visual approach. One could see birdwatchers with their cameras at all the opportune spots around the airfield fence. Some even waved to us as we taxied to our parking hangar!

On 18 May, '958 satisfactorily completed the JCS-directed training sortie over the North Sea. The aircraft was configured with the same sensor package that it would carry aloft during the two operational missions, namely the nose-mounted HRR, ELINT sensors in the two aft mission bays (bays S and T) and a full DEF system.

20 MAY, 1977

Tom Alison recollects the coordinated mission with the RC-135 over the Barents Sea:

J. T. Vida, my RSO, and I arrived at RAF Mildenhall via a KC-135Q along with the TDY detachment commander, Col Willie Lawson, and the nav/planner, Lt Col Red Winters. This particular mission was tasked at the top secret level to make two passes using High Resolution Radar imagery and ELINT sensors against the Soviet Union naval submarine base at Murmansk on the coast of the Barents Sea; it was also scheduled as a coordinated mission with an RC-135V 'Rivet Joint'.

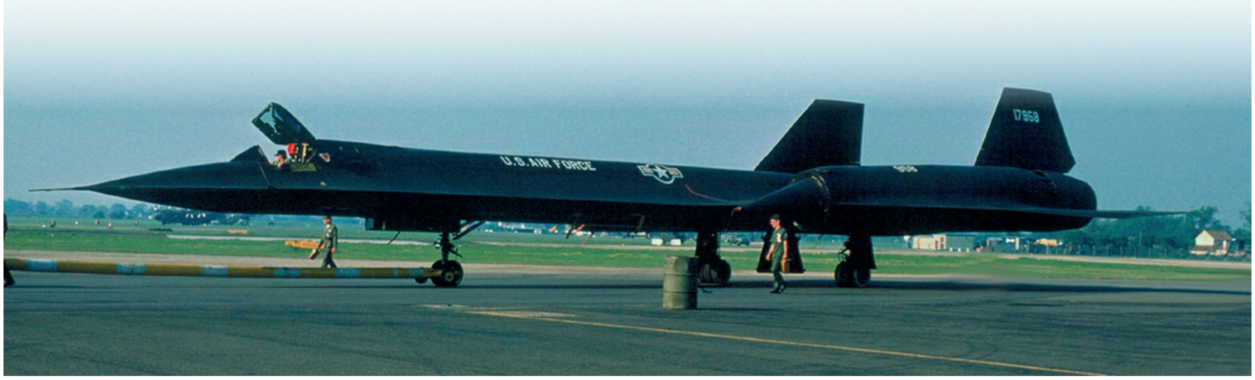
It was a little unusual for a PARPRO mission to be classified top secret, but J. T. and I just thought that was because it was a coordinated sortie and one of the first to go in the area around Murmansk. It may also have been due to the fact that the Soviets had deployed the SA-5 surface-to-air missile in the Murmansk area and it would be one of the first occasions that the SR-71 had been used in an area where there were known SA-5s, a much more capable SAM than the SA-2, which was widely deployed and was not considered an extreme threat to the Blackbird.

During the mission planning session the day before, it was discovered that the Soviets had issued a Notice To Airman (NOTAM) warning of surface-to-air missile test firing from the surface to in excess of 100,000ft. The coordinates of the area were off the coast of Murmansk, and bracketed very nicely the only place on the mission where we would fly through the same area twice, going in and coming out. We were always concerned about prior awareness relating to SR-71 missions, and this seemed like a highly improbable coincidence. Maybe, somehow, the word about our mission had leaked.

Although at the time J.T. and I were not really aware of it, it seems that in some quarters this possible security leak caused quite a bit of concern. Apparently, there were several secure phone calls made between RAF Mildenhall and the SAC Strategic Reconnaissance Centre, and the discussion centred on whether or not to cancel the mission based on the NOTAM. It should be noted that the mission track was planned entirely in international airspace. If we stayed on the 'black line' we would never enter Soviet airspace. However, that said, the mission was planned to obtain maximum information concerning the submarine activities and area defences. At one point during the second pass through the area, the Blackbird was planned to be heading directly at the submarine base, perpendicular to the coastline at Mach 3.15. At a certain point we began a high bank turn that would put us parallel to the coastline headed out of the area. That point was right in the centre of the 'missile-firing box' outlined by the NOTAM.

The concern centred on whether the Soviets would actually fire an SA-5 against an aircraft in international airspace. 'Intent' was always a key word in a situation like this. Another concern was that the SA-5 was new and relatively unknown in terms of RF indications and performance. We were later told that Kelly Johnson was actually part of the conference and his position was that we should not fly the mission as scheduled. In the end, though, it was determined that the sortie would be flown as scheduled.

The following day we all got airborne on time, the RC, the 'Q models', and the Blackbird. Our mission profile was normal through the refuellings, but as we began our climb and acceleration to Mach 3+ cruise prior to entering the target area it became obvious that the outside air temperature was much higher than we expected and were used to. This causes the climb/accel to be slower than normal. It was so hot, and our performance so degraded, that at the point where we should have been level at Mach 3.15 and 75,000ft, we were just passing 60,000ft and still climbing, and we were only accelerating through about 2.8 Mach. J. T. and I were discussing our situation and he mentioned that the radar sensor had just come on. We had never had it come on while we were still climbing before. Additionally, the slower performance caused us to be well below the planned fuel curve. Decisions, decisions.



SR-71 '958 deployed to Mildenhall from 16 to 31 May 1977. (Bob Archer)

Majors Rich Graham (left) and his RSO Don Emmons completed the first SR-71 operational mission out of RAF Mildenhall on 7 September 1976. (USAF via Rich Graham)

Part of the 24-van MPC II, located within a secure compound inside Hangar 538. (Paul F. Crickmore)

We decided to press on and finally got levelled off and up to our desired cruise speed. We actually pushed the Mach up a little to try and help ourselves get back on the fuel curve. Although I knew we would never be able to make up all of it, I was comfortable that we would be able to get back to the tankers for the next air refuelling – if nothing else went wrong. And, in fact, that is just what happened. We completed both passes through the target area, and the missile firing warning area, with very little reaction noted on our defensive systems. The last air refuelling and the trip back to Mildenhall were uneventful. Just the way we liked it.

During the debriefing following the flight, we received word that we had already had a very successful mission, and our radar take had not even been processed yet. It seems the RC-135 Rivet Joint, which was in the target area for some time before we arrived, had quite a bit of Soviet company in the form of interceptors. At the point in time where we were beginning to enter the area, the RC crew became aware that the interceptors abruptly departed and the linguists monitoring the radios overheard the Soviet GCI trying to vector the interceptors to the SR-71. At least one interceptor pilot was heard to say, 'I can see the contrail above and ahead. It is climbing at a very high speed and I will not be able to catch it.' Heck, we already knew that!

Further adding to the success of the mission was the capture of specific RF signals associated with the SA-5, which were picked up by both our systems and the systems on the RC. J. T. and I had spent 45 minutes in the 'denied area', most of it at a little in excess of Mach 3 – just another day at the office.

Total mission time was four hours two minutes, of which 45 minutes were spent completing the two reconnaissance-gathering passes.

Majors Tom Alison (left) and his RSO J. T. Vida flew the first operational SR-71 sortie from RAF Mildenhall, coordinated with an RC-135. (USAF)

14845
U.S. AIR

An RC-135V Rivet Joint of the 55th SRW, similar to the one pictured, took part in a coordinated mission with SR-71 '958 over the Barents Sea on 20 May 1977. (Bob Archer)

24 MAY 1977 MISSION

Buz Carpenter recounts the operational mission over West Germany:

> Next flight up was for John and I to fly the tricky German mission. Like later Baltic missions, one could not fly the aircraft at Mach 3.0 and make the turns that were required in order to stay within the country border limits that were imposed upon us. In both cases, while flying at Mach 2.8, a maximum 45°-bank high angle turn was required to stay within the confines. Because of aircraft energy management, a slight descent was sometimes required to maintain the 45° of bank and 2.8 Mach. These turns were therefore planned for 42°, which gave you an additional 3° to use to maintain your critical ground track. [With an ambient air temperature of -56.5°C and a 42° bank angle at 2.8 Mach, the turn radius was 42nm]. The problem was that the steeper the bank, the more likely the loss of altitude in the turn. If you were flying in warmer than standard air temperatures, it further aggravated this energy management balance. Often we would descend a couple of thousand feet just before the turn to give ourselves an energy advantage.
>
> To provide as much secrecy as possible, the mobile crew would reaffirm our take-off time and that our flight clearance was ready. With this check complete, we would initiate our engine start and aircraft systems check without any radio calls about 30 minutes prior to take-off. The Mildenhall control tower would flash a light to signal our clearance to taxi and to enter the runway for take-off. With the UK airspace de-confliction completed, a green light would be flashed to us from the tower and a radio silent take-off would then occur.
>
> Traffic had been cleared from our path and we climbed unrestricted to 25,000ft and headed out over the North Sea to meet our tankers. When the refuelling was completed, we executed a right turn

to the southeast and initiated our climb and acceleration.

Our entry target was to cross the German coast near Wilhelmshaven at Mach 2.8 above 70,000ft. Our heading was almost due south, towards Kaiserslautern, avoiding overflying major population areas. Below us most of the ground was covered with low clouds. This track was followed by a 30°-bank turn to the southeast, passing southwest of Stuttgart and heading into Bavaria. Here the cloud cover broke and the landscape was a wonderful patchwork of little villages, agricultural fields, and mountainous terrain.

Now came the difficult manoeuvre to ensure that we maintained our track inside of West Germany, while flying south around Munich while executing a 45° high-bank turn. Luckily, during this particular day there were some clouds below and the cooler than standard upper air temperatures enabled us to maintain our altitude. During these turns, as much as one would have liked to have taken advantage of the spectacular views out of our down side turn window, full concentration was required to make sure one executed this high bank turn exactly as planned – maintenance of the ground track was paramount, as this had been promised to America's National Security leadership. Bank angles, Mach stability, engine performance, absolute ground track, and all other aircraft systems had to be intensely monitored to start corrective actions if deviations became apparent. Nothing would be said in the turn unless it was essential to this turning process. The 180° plus turn placed us north of Nuremberg, flying northwest beside the inner German border.

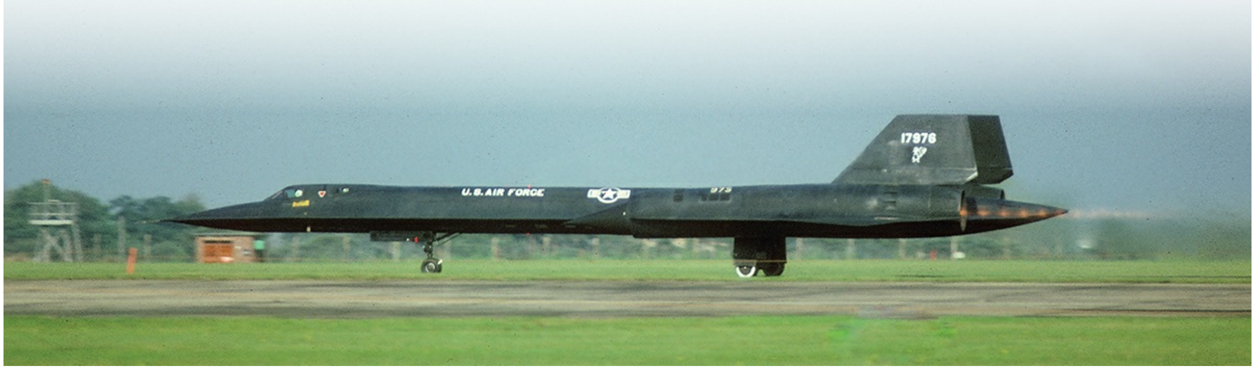
Majors Buz Carpenter (left) and his RSO John Murphy ferried '958 to Mildenhall and conducted an operational sortie along the East/West German border. (USAF via Buz Carpenter)

Photographed on 24 October 1977, RC-135U 64-14849 climbs out from Mildenhall en route for a coordinated mission with '976 which was inbound to Mildenhall via the Barents Sea. (Bob Archer)

Basically, our sensors ran the whole time along the inner German border objective area. Once abeam Frankfurt, passing to the north, a turn north was completed to align us to depart Germany in the same coastal vicinity we had entered less than an hour earlier.

Once clear of the coast, we started a 30° descending turn to the southwest. It took over 200nm to start a descent, decelerate and level off at 25,000ft inbound to England. There was not much margin for error or any type of delay in the close confines we were operating in. This all happened very quickly, as descents were another high-activity time period to make sure the aircraft maintained those narrow flight parameters to allow for a safe descent. Engine compressor stalls could occur with engine flameouts if your tight descent profile was not maintained. Once below 2.4 Mach the profile became more flexible and at 1.8 Mach, with the inlet spikes full forward, there was even more latitude. This whole descent was designed to be ready to enter the English landmass subsonic. Approaching England we would then break radio silence and contact Northern Radar and follow their guidance for an instrument recovery back at Mildenhall. English air traffic control sector radar controllers and, when required, their precision radar approach controllers were superb – this in part may be because of all the practice they receive with England's notorious weather!

From operational missions a single approach full-stop landing was always planned. After landing and deploying our huge orange drag 'chute, slowing was closely monitored and once below 80kt, the drag 'chute would be jettisoned if there was not a severe crosswind. As we taxied in front of our parking hangar, the sensor crews were already in place to immediately download the sensors and process what we had collected after we had stopped. As the engines were shut down, sensor crews were already under the aircraft opening hatches and by the time John and I stepped from the cockpit most of them had already been downloaded – mission duration was two hours 22 minutes.



During its 20-day stay, '976 flew eight operational missions along the Iron Curtain to monitor the Soviet autumn troop rotation. It's seen here departing on 16 November 1977 – note the chalk Skunk on the tail. (Bob Archer)

Aircraft systems and anything unusual from the mission was debriefed at planeside before we were driven back to the PSD building and de-suited. This would be followed by extensive debriefs and then it was our turn to assume the mobile back-up position for Tom and J. T. for their next scheduled mission.

As a postscript, about two weeks later we were informed that our TDY at Mildenhall had been extended to support the Air Tattoo celebrating the Queen's Silver Jubilee. A two-day open house would attract well over 100,000 visitors and the SR-71 would be on its first British public display since setting the speed record from New York to London in 1974.

The SR-71 would be part of the static display, but roped off so people could not touch the aircraft. We had been advised to watch for representatives from the Soviet Union and Eastern satellite countries trying to get too close to the aircraft and securing material samples. To prevent the Russians or anyone else from exploiting the display, no sensors were left on the aircraft, all fuel had been removed from the tanks and the aircraft was heat soaked to ambient temperatures to prevent infrared cameras from discovering the secrets of the aircraft's internal structure and support systems.

As we four crewmembers were standing around the aircraft answering questions from the crowd, sure enough the Russians showed up in numbers. They took numerous regular and infrared photos and some of the Russians even had hidden microphones. They were a sight to see, coming up like a covey of quail. It looked like the Salvation Army had outfitted them. Their dress sense was that from a 1930s movie about American mobsters. They were attired in bulky double-breasted suits made from rougher cloth than one normally sees, and all clustered around each other waiting for their leader to act. The head of the Soviet delegation, a former MiG-23 fighter pilot, was quite relaxed and talkative in his demeanour and invited John and I to sometime drop in on Vladivostok in the Far East as a gesture of peaceful relationships. We just quipped, 'Please forward that request to our State Department.' The British open house audiences are much more aviation literate than their American counterparts. Tough aeronautical questions were often asked as we stood by the aircraft in the static display, but a great time was had by all, with wonderful weather and spectacular flying demonstrations. On 31 May 1977, Tom and J. T. redeployed '958 back to Beale AFB using the call sign Resay 35.

The Soviets established so-called bastions to protect their nuclear sub bases along the coasts of Vladivostok in the east and the Barents Sea in the north. The SA-5 Gammon was an integral part of that defence system. (Matej Kopecky via Paul Crickmore)

ANOTHER RESTRUCTURE, ANOTHER DEPLOYMENT

To improve command and control of its forces in Europe and to further strengthen liaison between the CINCSAC and the US and allied commanders in Europe, Headquarters SAC activated the 7th Air Division at Ramstein AB, West Germany on 1 July 1978 as a direct reporting unit. It also moved 'on paper' the 306th Strategic Wing from Ramstein to RAF Mildenhall, which until this date had been Detachment 1 of the 306th at the UK base.

Even before the Habu's first European operational deployment had begun, planning was already under way for a second, which was scheduled to occur in the autumn of 1977. European commanders were anxious that the SR-71 should again participate in exercise Cold Fire; however, recce specialists at HQ SAC were sceptical as to the value of such an exercise, mindful of the limitations imposed upon the aircraft's sensors when forced to adopt a highly restrictive flight profile in order to conform with political considerations based upon Switzerland, Austria and France's decision to deny the SR-71 clearance to overfly their airspace.

The first of the so-called Big MiGs was the MiG-25, designed specifically as a point defence platform against the SR-71 and high-flying nuclear bombers like the B-58 Hustler and B-70 Valkyrie. (Yefim Gordon)

However, the success of the first deployment ensured that Maj Gen Earl Peak's (SAC Deputy Chief of Staff for Operations) request to the JCS for an October/November deployment was approved. The year's second PARPRO deployment was planned to leave Beale on 20 October 1977, fly eastward from Beale over the Arctic Circle and conduct a coordinated intelligence-gathering sortie with the RC-135U Combat Sent II, serial 64-14849, in the Barents Sea, before recovering into Mildenhall. (64-14849 flew 30 operational missions into the Baltic and Barents Sea areas during this, its second, or Papa deployment to Mildenhall in 1977.) However, due to bad weather at Thule AB, Greenland – the SR-71's nominated emergency recovery base for this deployment – the mission was delayed for four days and Capt Joe Kinego and his RSO Maj Larry Elliott completed the five-hour 49-minute mission to Mildenhall in aircraft '976 on 24 October. During the sortie, Joe firstly conducted a post-take-off top-up near Edmonton, Saskatchewan, Canada; a second AR was completed near

Greenland and a third after 'the take' off the coast of Norway.

During this tour it was planned to fly several more sorties than on previous UK deployments; consequently, two additional Habu crews arrived via KC-135Q tanker to gain valuable experience in operating in this unique environment. They were Bob Crowder and John 'Jack' Veth, together with their respective RSOs, John Morgan and Bill Keller.

Between the three crews, eight round-robin sorties were flown into West Germany, on 27 and 29 October, and 1, 3, 6, 7, 10 and 11 November. The average mission time for these sorties was 2 hours 38 minutes, and involved one air refuelling over the Wash, a large bay-like area off the northern coast of East Anglia, shortly after take-off. The route consisted of just a single pass along track X-027, which was aligned parallel to the East German/Czechoslovakian borders, specifically to monitor the Soviet/Warsaw Pact autumn troop rotation. Headquarters EUCOM requested that SAC direct the SR-71 to collect as varied an ELINT/HRR sampling as possible. Consequently, the 3 November mission launched after sunset and completed a night sortie, a practice seldom undertaken because of noise considerations.

THE S-200 (NATO DESIGNATION, SA-5 GAMMON)

Another important target for SR-71 reconnaissance missions in Europe was monitoring the deployment of SA-5s, the largest, longest ranging Surface to Air Missile (SAM), developed and operationally deployed by the Soviet Union. With a range of up to 160nm, this highly effective missile continued to be deployed throughout the 1980s, and numerous sites were constructed in a chain extending from East Germany, through Poland, Czechoslovakia and terminating in Hungary. The intention behind this SAM belt was to deny NATO the use of Intelligence Surveillance and Reconnaissance (ISR) gathering assets, specifically the SR-71, E-3 AWACS, E-8 JSTARS, RC-135 Rivet Joint and TR-1/U-2Rs, thereby producing an 'ISR lockout'.

Since its initial deployment, the SA-5 received five major upgrades to increase the missile's range, accuracy and payload. Each battery consisted of six trainable, semi-fixed, single rail launchers, that were supported by a pair of rail trans-loaders, thereby enabling up to 12 reloads. The very complex system required the integration of a network of different radar types. Early warning was provided by Big Back, D band long-range radars; target search and acquisition utilized the Bar Lock E/F band surveillance radars and fire control was provided by a Square Pair H band radar, which had a range of 170mls. The missile was launched by four solid-fuel, strap-on rocket boosters that burned from between 3 to 5 seconds, after which they dropped away and further power was provided by a single stage, liquid motor. The SA-5 utilized semi-active radar homing throughout its flight, which was far more accurate at long range than the command guidance method, used by the earlier SA-2 missile defence system.

Depending upon variant, the SA-5 had an effective altitude up to 115,000ft and could engage targets flying at speeds of between Mach 4 and Mach 6. Its 478lb, high-explosive warhead consisted of 16,000×2g fragmentation pellets or 21,000×3.5g pellets, and was triggered by either a radar proximity fuse or command signal. At launch, the missile weighed approximately 15,670lb and its dimensions remained about the same throughout the different variants, with a length of 35ft, and a diameter of 2.8ft; each booster had a length of 16ft and diameter of 1.5ft.

During the 1980s the Soviet Union exported the SA-5 to numerous countries both within and outside the Warsaw Pact. As will be seen, it was an air defence system that attracted both interest and a certain amount of respect from HABU crews.

17964
U.S. AIR FORCE

Majors Jay Murphy and John Billingsley deployed ’964 to Mildenhall on 24 April 1978. Note the dark green Buick start cart, parked under the aircraft's left wing and used to crank the engines. (Bob Archer)

FIRST BALTIC MISSION

On 16 November 1977, Maj Bob Crowder and his RSO Capt John Morgan returned '976 to Beale, using the callsign Dew 49. Departing Mildenhall, the first AR was completed over the North Sea. However, before heading for home, '976 turned east and entered the Baltic Sea. In anticipation of the Soviet's likely response, two RC-135s, including RC-135U 64-14849, and an unconfirmed report of an RAF Nimrod R1 were already on station, patrolling at 26,000ft in readiness to monitor the situation. Surprisingly, neither the Soviets nor the Swedish Air Force scrambled fighters in response to the Habu's arrival. So having successfully completed the first of what would later become known as a 'Baltic Express' mission, Bob and John topped up '976's tanks in a second AR over the north coast of Scotland and a third off the east coast of North America, before touching down at Beale after a flight lasting 6 hours 11 minutes. Throughout the two deployments in 1977, both the SR-71 and the MPC performed flawlessly.

On 24 April 1978, Justin 'Jay' Murphy and his RSO, John Billingsley deployed aircraft '964 to Mildenhall to cover the Soviet spring troop rotations. During the 16-day period of its stay, two crews flew the aircraft, and for the second consecutive deployment Bob Crowder and John Morgan ferried the aircraft back to Beale on 12 May – but not via the Baltic.

On 16 October 1978, Rich Graham and Don Emmons again deployed '964 to Mildenhall. This time the stay lasted 16 days, and BC Thomas together with Jay Reid took turns with the Stan/Eval crew, to collect RADINT and ELINT of the troop rotation.

As mentioned in Chapter 12, earlier in 1978 Admiral James A. Holloway III Chief of Naval Operations (CNO) had requested that the Defence Intelligence Agency (DIA) validate a requirement to use the SR-71, equipped with its high resolution, synthetic aperture radar, in order to monitor Soviet Delta-class submarines equipped with nuclear Submarine Launched Ballistic Missiles (SLBMs). With SR-71 missions venturing into both the Barents and Baltic Seas, this evaluation could have easily been undertaken during its deployments to the UK. However, in the event it was decided that this trial would be executed by

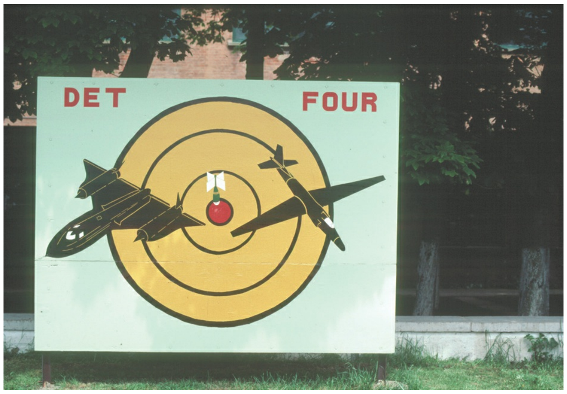
Det 1 of the Soviet's Pacific Fleet, located around Vladivostok and Petropavlovsk.

YEMEN

In early 1979, the established cycle of SR-71 European deployments during the spring and autumn was interrupted and increased by the threat of yet another war in the Middle East.

Situated on the tip of the Arabian Peninsula and at the southern approach to the Red Sea, North and South Yemen bordered oil-rich Saudi Arabia. One of the few Arab nations friendly to the United States, Saudi Arabia was the largest foreign supplier of oil to the US.

Throughout the 1970s, South Yemen had received military aid from China and the Soviet Union. In addition, it had repeatedly tried to undermine the more moderate government of North Yemen. Saudi Arabia had close ties with North Yemen, but not with the left-wing government to the south. On 24 February 1979, while the South Yemeni foreign minister was in Riyadh, pledging that his government would support Arab League arbitration over the problems that existed between North and South Yemen, his country invaded its northern neighbour.



On 31 March 1979, Det 4 of the 9th SRW was established at Mildenhall. As its first unit badge clearly shows, at this early stage the det was a joint SR-71/TR-1 operation. (Bob Archer)

It was an action that caused considerable consternation within the Saudi royal family, which feared that a united Yemen under a Marxist government would infiltrate and seek to threaten their country's fragile political stability. So, in response to a Saudi request made through the DIA, the JCS directed HQ SAC to deploy an SR-71 to Mildenhall on 12 March 1979, one month before the scheduled deployment to cover the spring Warsaw Pact troop rotation. It was tasked to conduct a single Giant Reach special mission into the Middle East and secure surveillance relating to events in this latest hot spot.

Despite a 3 March ceasefire that supposedly came into effect between North and South Yemen, intelligence sources advised the DIA that fighting had continued, particularly in the regions of Qatabah and Harib. As a result, the JCS's earlier decision to deploy still stood.

Back at Beale AFB, the saga picked up with the arrival of a SAC Operational Readiness Inspection (ORI) team. The team chief was none other than Brig Gen Pat Halloran, former 9th Reconnaissance Wing commander, SR-71 pilot and flight instructor. Buz Carpenter takes up the story:

> For the aircrew members this was normally not much of a challenge, since most of the SAC inspection team members weren't cleared to see the classified aircraft systems and particularly our ongoing peacetime missions. During this period, we were flying 10–15 operational missions a month, from Beale, Kadena and occasionally Mildenhall.
>
> So instead, we would take an aircrew bold face emergency action checklist test: all checklist items had to be from memory and errorless in order to pass. Maintenance had to generate all the aircraft as if they were to be flown and deployed. We would inspect the aircraft and bring each SR-71 up to the engine start configuration and then the inspection team would certify the aircraft as generated and ready. Other weapons systems had to actually launch their aircraft and demonstrate flying and weapons delivery activities, plus their ability to execute their assigned missions; we were scored on the actual success rate on the operational missions we had been tasked for during the previous two years. Our average was always above 90 per cent, which always gave us an outstanding mission execution rating.
>
> The SAC ORI team arrived on Wednesday, as I remember, and we completed aircrew testing on Friday, together with acceptance walk-throughs on the generated aircraft. An aircrew or two was normally selected to conduct a simulated mission in our incredible computer-supported simulator. For its time, it was one of the most advanced mission simulators in the USAF. One did not even need an instructor on the console; as the aircrew executed actions, the simulator knew how the aircraft would react and 'put the aircraft' into that environment.

'979 was deployed to monitor the spring deployment of Soviet troops on 1979 – note the 9th SRW badge on the tail. (Bob Archer)

There was going to be an aircrew 'solo' party that Saturday night, so a number of us thought it would be fun to go up to the Reno air races on Saturday for the day. Much to our surprise the squadron commander said we needed to stay on base and if we had to leave the base, we had to stay in the local area and in touch with the squadron (this was pre cell phone days, so it was a much tighter leash for all of us). We thought that this was rather unusual, because basically our part of the ORI was over.

On Saturday everyone stayed close to base and that night we had the 'solo' party. It was customary during SR-71 flight training that as the pilot and RSO first flew together and then completed their first Mach 3+ flight, they would individually host an open bar at Beale's officers' club. This was not an insignificant bill, but one everyone was delighted to step up because of what it signified. When the crew pilot and RSO were far enough along in their training that they were now flying together, they would host a party for the crew force and key staff members. This particular Saturday was one such event.

As people were moving around congratulating our newest aircrew and exchanging whatever flying stories of the day, one could detect rumblings of something happening in the background. There was trouble somewhere in the world and an initial planning call must have been made to the SR-71 organization to get ready for action. Speculation was rife and the same old questions were being asked: 'Where is the trouble? Are we officially tasked? Where might we be deployed to execute these mission(s) from?' And of course, most importantly, 'Which crews are likely to be selected to support this effort?' As bits and pieces of information were revealed, a picture and a timeline formed for deployment action probably within the next week … but the only thing we knew for sure was that we'd be heading east from California to deal with the crisis.

At about 10:00pm and with the party in full swing, Col Willie Lawson, the director of operations for the SR-71 programme, came up to John Murphy, my RSO, and me stating we needed to come into mission planning around noon tomorrow to look at some maps for potential operations. John and I welcomed this opportunity, but it did not mean we would be deploying; that decision was yet to be made. I remember it was a great party, but with little more information than this being learned, John and I, together with our wives, left the party sometime after midnight.

I was planning on getting up [11 March], for our normal Sunday routine. I would get the family breakfast and then we would all go off for the chapel service on base. Well, at 7:30am I get a call saying that I needed to get John and head for the planning shop. I asked if it could wait until noon and the answer was a clear, 'It needs to be now'. I called John and picked him up about half an hour later and we headed down to the mission planning area. Now we got the Paul Harvey routine … the rest of the story. Problem in the Middle East – Yemen and Saudi Arabia are about to go to war over border disputes. Tanks have already started to assemble and information needs to be gathered as quickly as possible to give the president and the National Security Council, along with the State Department, an opportunity to defuse this building conflict.

John and I looked the mission paths over, as the package called for three missions flown into the Middle East at about two-three days apart, from Mildenhall. Our routes to the Middle East from England are known. Once again, the French refused to let the SR-71 fly across their country for quick access into the Mediterranean Sea thereby reducing this five-refuelling, almost 10-hour mission by 2½ hours and a refuelling.

The major task of the morning was to look for suitable refuelling bases for our tankers. The special JP-7 fuel was stored at Mildenhall, Incirlik AB, Turkey and, I believe, at Moron AB near Seville, Spain. Turkey and Israel said the tankers would not be allowed to operate from their countries. Saudi Arabia was not chosen, but I do not remember why. Finally, Cairo West in Egypt was selected, and the tankers would have to pick up fuel from Turkey but not support us from there.

As one can imagine, the most critical aspect for timing was for the tanker operations to determine their best basing sites and then get the tankers, aircrews and maintenance support heading to these locations. The SR-71 might be able to fly at Mach 3+, but without the tankers, which took a while to get to their forward-deployed locations, the SR-71 was not mission capable.

At about 11:00am, John and I were told we'd be part of the advance party heading to Mildenhall to receive the SR-71 deploying from Beale, which was being flown by one of our most experienced and senior crews, Maj Rich Graham and Maj Don Emmons. [We were told] 'Oh, and by the way, you'll leave sometime this afternoon or early evening.' John and I called home and asked our wives to ready our bags. By about noon the ORI team had stopped all evaluations and was now just watching this magnificent reconnaissance team in action, doing what we were supposed to do for the United States. I kidded Gen Halloran that this is the 'best ORI scenario I have ever seen.' We both laughed, because this is what it is all about and why so many men and women have so dedicated their lives to serving their nation this way.

We got a quick trip home at around 1:00pm to pick up our bags and say goodbye. We did not know when we would be back. The families would be given that information as soon as it could be determined, but they weren't told where we were going nor anything about the missions that needed to be flown, as that was all classified. A quick stop by the squadron to pick up our checklists and various deployment materials: we had to secure a special UHF radio and other items to be used by the mobile crew to launch and recover the SR-71 from our deployment base at Mildenhall.

Early Sunday morning the tankers were already starting to depart before their final destinations were known. Since their missions involved multiple flight legs, time was the most critical factor in getting them forward and set up to operate. Operational locations, diplomatic clearances and operational concepts would be worked while the tankers were en route.

John and I were told we would be leaving around 4:00pm, with a refuelling stop at Pease AFB, New Hampshire and then on to Mildenhall, arriving an hour or so ahead of the deploying SR-71. It would be tight timing, but we needed to get the aircraft on the ground in England so that maintenance could turn it around once the tankers were forward and prepared to support, and an execution time was determined. Sensors would have to be prepped and uploaded – some of them needed almost a day to get them mission ready. Primary sensor for these missions would be the optical bar camera carried in the nose of the aircraft. We called it the countries camera, because it was an area camera that took a swathe about 70 miles wide and thousands of miles long.

A last-minute delay meant that our tanker didn't depart Beale until nearly 6:00pm [Sunday evening]. Time would be really tight now. We flew to New Hampshire at the KC-135's top speed. A quick refuelling turn was a must at Pease, so the tanker aircrew called ahead and tried to have everything ready to go for our high-priority mission. Fortunately, it was September and the weather was at its best, an operation such as this in the dead of winter would have added yet another dimension of time risk. But after landing, I remember the operation was a fine orchestration from this Northern Tier Strategic Air Command Base. Fuel trucks were standing by to refuel, with box lunches for the tanker aircrew and all of us passengers. John and I went into base operations and made a few essential telephone calls to update the overall mission status, determine a revised arrival time for the SR-71 into Mildenhall and receive any further instructions. We then rushed back to the tanker and shortly afterwards we were back in the air, heading across the North Atlantic to Mildenhall.

John and I had the tanker call Mildenhall about an hour before landing to reaffirm that the mobile car would be planeside as the tanker's engines shut down. On landing, we had at most 30 minutes before the SR-71 touched down. We leapt into the car, hot-wired the special radio into its electrical system, mounted its external antenna, and proceeded immediately towards the runway to complete our recovery checklists; this included gaining clearance from the tower to access the runway and carry out a visible inspection for any possible FOD [foreign object damage] items that could puncture the SR-71's tires.

As we were checking the runway for screws, bolts, panels or whatever, John made contact with Rich and Don, affectionately known as 'Snake' and 'Nape'. They were about 10 minutes out and about to go over to approach control for recovery. We played about a minute of *Darl'n*, a David Allen Coe song that had almost become the theme song for the SR-71 programme at this point in time. It was late in the afternoon as #972, using the callsign Awry 26, touched down; I recall the weather was pretty good for England. Birdwatchers as usual were along the fence to film anything that might be flying on this Monday.

Tankers were still getting into position and the mission planning team with us worked into the night, planning the three-mission objective routes over the Arabian Peninsula, focusing on the Saudi-Yemen border.

Refuelling tracks had now been established, with the first off Land's End, England, the second in the Mediterranean Sea, a third over the Red Sea going in and a fourth again over the Red Sea coming out; the final refuelling would be a long drag over the central Mediterranean, abeam Libya, to get us home. Because we were banned from flying over France, the last leg would be critical on fuel. Even with the priority handling British air traffic control provided us, fuel would be tight and English weather was always an additional risk.

By the afternoon of Tuesday 13 the tankers were in place and, if the weather permitted, we could launch the first mission early Wednesday morning. Early departure was required to place the SR-71 over the Arabian Peninsula with optimum daylight for the cameras. Rich and I had already talked about who would fly which missions. I volunteered that I would not mind flying these longer missions, so the plan became that as they had brought the aircraft over, John and I would fly the first and third missions – up to 10 hours in length – and Rich and Don would fly the number two mission and then take the aircraft back to Beale … a four-hour flight.

As I remember, we met at about 3:00pm Tuesday afternoon and there were representatives from many organizations we did not normally see. This attested to the importance of the mission. We had attachés from our embassy, senior National Security Agency reps, the two-star USAF Director of Operations from SAC and many others. The USAF two-star had questions about our operations, was interested in the route we were about to fly, potential divert bases and the rules of engagement we were given to operate with.

Humour entered at this point when asked if our families knew where we had left for. My answer was no, my wife Nancy knew it was an important mission and her parting comments to me were, 'Do good and I do not want to read about you in the paper or see you on the TV!' That was the nature of our business. Our families were truly most supportive.

The briefing went along fairly well until we got to the issue of possible divert bases if we had trouble. The State Department folks asked 'what do you mean trouble? Aren't you guys invulnerable?' Well, even the best of aircraft occasionally has a maintenance problem. Israel had denied us any overflight, and with Turkey's position of not wanting to support this operation from any of their bases, this left us with few options. John and I selected some bases we could use in the Mediterranean and in the objective area. We normally flew our missions radio silent, with a listening watch on HF radio for recalls or mission changes. Our tankers would include anything we wanted passed on as part of their end refuelling radio report. One of the great features of the SR-71 refuelling capability was the ability to talk with the tanker aircrew through the air-refuelling boom, thereby maintaining radio silence. For this mission we were told [that President Jimmy Carter] had requested through the National Security Council that the SR-71 report operationally normal at the end of each refuelling for immediate mission status verification.

Now started the process of going to bed around 6–7 o'clock to be rested before getting up at 1:00am in the morning for the physical, a breakfast of steak and eggs, mission briefing and then the suiting up process in order to be ready for about a 4:00am engine start. On the morning of Wednesday 14, we went through all the steps, including being installed in the aircraft. John and I were awaiting the thumbs up from Mobile (Rich and Don) to initiate our radio-silent engine start, taxi and take off. But at 4:00am word came through of a 24-hour delay because of weather in the objective area. We got out of the aircraft, talked with maintenance for a while and then tried to figure out what we were going to do until we went to bed around 6:00pm. Back at our room area we went and broke out some wine and vodka tonic drinks. The maids showed up at 7:00am and wondered what these crazy Americans were doing having a party so early!

And so off to bed we went on Wednesday night and got up again at 1:00am Thursday 15. Unfortunately, the same routine ended with the same results. At 4:00am, while strapped in the aircraft on a dark, wet taxiway, we got another 24-hour delay. It was okay for us, we could go back to our rooms, but for many of our tankers' aircrews, who had launched hours earlier to be in position, it was another long mission of burning down fuel until a safe landing weight was reached before they could land back at their respective deployment bases. Because of the restrictions imposed upon us, many of the tankers had to fly for a number of hours to be in the refuelling track to service us as we flew through. Wednesday had already found them burning down fuel and now the situation called for a repeat on Thursday.

That evening, I had an early seafood dinner at the Mildenhall Officers' club – unknown to me at the time, this would feature later in the story. Friday 16 we were up at 1:00am and hoping that this would be the day we finally executed mission number one. The weather was okay in the objective area but not really too good at Mildenhall, light rain and somewhat foggy. We were now at engine start and John and I have our fingers crossed. All of a sudden the crew chief and a Lockheed tech rep stormed up the ladder ... this was normally not good. I opened my helmet faceplate to determine the problem.

By way of a mission remembrance for our maintenance, intel and photo people, they wanted me to fly two plastic bags full of SR-71 tie-tacks. There was room in my lower suit leg pockets and I stuffed the bags in. I re-secured my faceplate and Mobile finally gave us a thumbs up. At last, we were off on this adventure. Everything went as scheduled and we blasted off into the night at about 4:30am and headed across England at 25,000ft towards the southwest and our tankers near Land's End.

This was quite a change, as we normally headed east out over the North Sea and hooked up with our tankers fairly quickly. As we flew west, I seemed to have more intestinal gas than normal. I figured it would pass as we climbed and the cabin pressure rose to 28,000ft. It was very common for us to work on relieving our gas build up as we climbed. It took almost 30 minutes before we were hooked up with the first of our tankers. By now I was feeling really uncomfortable. John and I discussed our options. We couldn't proceed if I was sick, but I sure didn't want the mission scrubbed and have it reported to the National Security Council that after two nights of mission slippage the mission was again postponed because the pilot was sick!

Well on the second tanker I had a quick complete diarrhoea attack (seafood special we figured), but afterwards I felt much better. Then came the next question: Were there any adverse effects for 'sitting on this stuff' for the next 9 hours? John and I discussed this with the tanker crew and I felt that as I was now fine we could proceed.

We dropped off the tanker over the Atlantic Ocean and with a full load of fuel began our climb and acceleration while heading due south. The sun had come up and we arrived at altitude at 3.0 Mach and about 74,000ft. A turn east was executed, taking us through the straits of Gibraltar and into the Mediterranean. I now felt actually pretty good and we set up to initiate our descent and deceleration for our second refuelling. All was normal from these tankers that came out from Spain and they were extremely glad to see us for what was for them a third flying day. As directed, at the end of the aerial refuelling we called operationally normal and started our next accel and climb.

So far there had been no reactions from any potential hostile areas. Now departing the Mediterranean, the view of the great Pyramids and Sphinx was spectacular! Time to start down once more. John said we were not getting the normal ranging information from the tankers to adjust our rendezvous profile. Unbeknown to us, the tanker radios were not working, but they actually saw our contrails as we started down and experience guided them to set up their turns to roll out in front of us at the right spacing and speed. What can I say… outstanding teamwork and a typical can-do attitude that makes it all happen.

The refuelling went without a hitch, but we were unaware that two Egyptian MiG-23s had followed our tankers out on this third day to see 'what was going on'. Unknown to us, a picture was taken of us refuelling from the other tanker from above, which months later John and I signed and which was then presented to the Egyptian Embassy and Egyptian Air Force to thank them for their great support. The picture was wonderful, showing three tankers in formation, us refuelling under the second tanker, and the pair of MiGs about 200–300 yards in trail.

With full tanks, we were now off for accel and climb number three, but this one would take us into our objective area. Defensive systems were again checked and all other aircraft systems were functioning normally. Aircraft '972 was performing exceedingly well, but now as we passed through 45,000ft at 2.4 Mach we got a fighter attack radar indication coming from our right forward quadrant. We determined that a Middle Eastern fighter would not be a threat to us at this speed and altitude (after returning to California I talked with Kelly Johnson about this event, he'd been cleared into any of the missions and occurrences we might see or experience).

A turn to the left was initiated as we reached 3.0 Mach and were above 75,000ft. What a view ... sand for as far as one could see, with the occasional interspersed oasis. Incredible to think of this vast open desert, and they were fighting over this. There was a lot of sand blowing around below us, making for a hazy scene. Above, the sky was as black as ever. As we flew over the Yemen-Saudi border area, a left turn for a second loop in this objective area was coming up.

Hardly a word was spoken between John and I during these intense, high-activity time periods. Just as everything seemed to be working as planned, the aircraft tried to make a right instead of the planned left turn. I disconnected the autopilot and got us turning left. John was working to see if he could locate the source of the problem and checking the rest of the objective area to ensure we had maintained route integrity. We were on that mythical black line and swung through for another pass.

Now as we left the objective area we were in a right descending, decelerating turn, looking for our fourth set of tankers. We were a little low on fuel because of the extra manoeuvring, but again the refuelling went without a hitch.

We were off the tankers again and climbing to start back to England. After this cruise leg we reached our last refuelling, number five, and then started the race home to return just under 10 hours of mission time. This last refuelling would be different from the rest, as a normal refuelling lasts about 15–20 minutes and transfers 80,000lb plus of fuel: the goal is always to reach your end air refuelling point with full tanks to begin your accel.

Well, for this last refuelling, we would stay behind the tanker for 50 minutes, dragging along subsonically, to give us a closer end air refuelling point, assuring extra fuel to deal with potentially bad British weather. This refuelling was in the middle of the Mediterranean Sea, north of Libya. Everyone was monitoring closely to see if Libya detected and reacted to our presence. Descent and hook-up went flawlessly. I debated dropping off the tanker a couple of times and re-engaging to top off the fuel in the aircraft, but the decision was made that instead of risking not being able to hook up again, the easiest action was to stay on the second tanker's boom for about 45 minutes. We saw a lot of air traffic over the Med, but none of it was out of the ordinary.

John and I were ready for this last leg. We had been in our pressure suits now for over 9 hours, and I would later learn that with the normal dehydrating 100 per cent oxygen breathing environment, coupled with my earlier illness, I had lost over 8lb even though I had been eating tube food and drinking water throughout the mission. Climb and acceleration were normal and we passed back through the Straits of Gibraltar and started a turn to the north heading home.

Prior to descent we learned that the weather at Mildenhall had deteriorated and it was now raining. Descent took us down to enter the English landmass subsonically and now we once again drove across the country. With approach control, we set up for a precision approach, but while running the checklist we determined that the nose gear did not want to come down. We were now in the rain and had to run the alternate gear-lowering checklist, which involved leaving the landing gear selection handle down, pulling some circuit breakers and then manually pulling a release cable in the front cockpit. During the course of running these actions, we had terminated the precision approach and could now take over visually for another approach. After the longest time, the nose gear did fall free and into the down and locked position.

Today we had fooled the birdwatchers, as there were very few around the airfield on this rainy day. Landing, thankfully, was uneventful, and as we taxied into our parking position outside of the hangar it seemed that all the deployment personnel were standing around cheering our mission completion. John and I felt so honoured to be a part of this great team. Engine shutdown commenced and the gantry stand was rolled beside us. I felt pretty good but a little weak. I tried to tactfully tell the gang to not get too close and there was a pervading odour.

Unknown to John and me, the first tanker had relayed our problem back and during the flight the team had organized a little ceremony. At the foot of the ladder the 9th Vice Wing commander, Col Dave Young, met me to get a quick debrief, but more importantly to present me with an SR-71 tie tack they had painted brown and the accompanying certificate attesting that on this date I was the first 'surely not true but funny' supersonic turd. What can I say… laughter came from everywhere. I felt pretty good, so the physiological support guys gave me my customary after-flight refreshing beer – rehydrating was also a critical part of this high flight.

As it turned out, our mission would be the only one flown into the Middle East for this crisis. All the data required by the National Security Council had been collected, meeting presidential requirements. On 28 March, John and I launched Snake and Nape into the air as Input 62, taking '972 home. Rich to this day kids me about tricking him into having the Chief of Standardization Aircrew act as a ferry crew for us. Such is the luck of life!

As 45 per cent of the target area was cloud covered, the PIs classified the quality of the PHOTINT take as 'fair'. However, it was good enough to establish that there was no military activity at any of the 24 primary targets. They were also able to verify that South Yemen had indeed withdrawn its forces from contested areas.

THE BALTIC AND BARENTS

Surveillance of the spring 1979 troop rotation was undertaken by Bill Groninger, Lee Shelton and Tom Keck together with their respective RSOs, Chuck Sober, Barry MacKean and Tim Shaw. Aircraft '979 was the platform, which was flown into Mildenhall on 17 April 1979, by Bill and Chuck, using the callsign Fern 29. The other two crews arrived by tanker, and having completed the TDY assignment, Maj Tom Keck and Maj Tim Shaw got the fast ticket home to Beale on 2 May after having first completed a sweep of the Soviet Northern Fleet in the Barents Sea 'collection area'.

The autumn troop rotation of 1979 was covered from 18 October to 13 November by Rich Young/Russ Szczepanik and Joe Kinego/Bill Keller in aircraft '976. Just as the year was coming to an end, on 24 December 1979, under the pretext of upholding the Soviet-Afghan Friendship Treaty, Presidium of the Supreme Soviet Leonid Brezhnev made a colossal error of judgment and ordered the invasion of Afghanistan. It would become the Soviet Union's equivalent of the United States war in Vietnam. Waged against insurgent groups known collectively as the Mujahideen, the bloody war lasted nearly ten years and cost the lives of an estimated 15,000 Soviet soldiers and about two million Afghan civilians. In the West, the invasion sparked strong condemnation and was marked by a steady downturn in the 'frosty' temperature of the Cold War in Europe.

On 9 April 1980, Maj Tom Alison and Maj J. T. Vida deployed '976 to Mildenhall. The two other Habu crews covering this Soviet troop rotation were Tom Keck/Tim Shaw and Bob Crowder/Don Emmons. According to an unsubstantiated Swedish Air Force based-report, on 24 April the SR-71 made two passes within the Baltic collection area. It's claimed that both passes were 'intercepted' by the same pair of J 35F Drakens – the first being a visual contact, the second pass resulting in both a visual and radar contact at 54,000ft. Bob Crowder and Don Emmons got the redeploy ticket and returned '976 to Beale on 7 May.

Aircraft ’972 arrived on 13 September as Cup 10 to cover the autumn rotation and stayed nearly two months, before leaving on 2 November 1980. Four crews shared the workload, but due to work on Mildenhall’s runway, the aircraft was positioned to RAF Lakenheath during the course of its deployment, from where it continued to operate until being flown back to Beale as Room 60.

U.S. AIR FORCE
17976

’976 was flown to Det 4 by Majors Joe Kinego and Larry Elliot on 24 October 1977 and returned to Beale by Bob Crowder and John Morgan on 16 November 1977. (Lindsay Peacock)

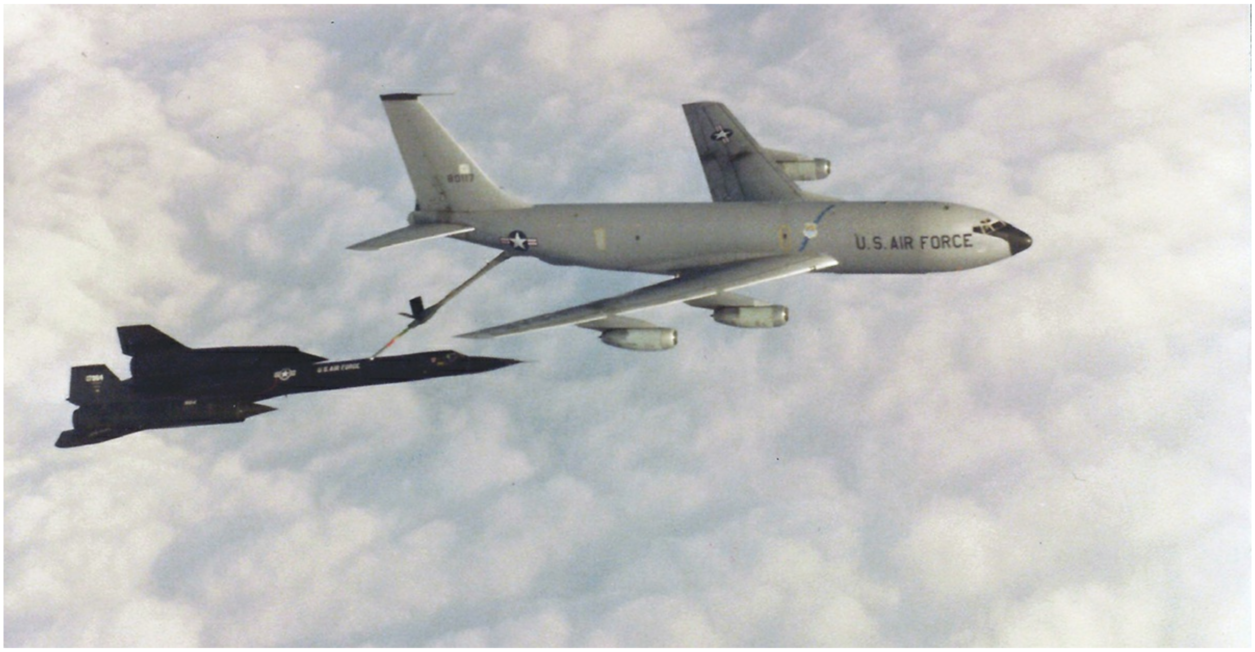
POLAND

On 31 August 1980, following a wave of strikes at the Gdańsk Shipyard in Poland, the country’s communist government signed an agreement that allowed the existence of the yard’s trade union. Seventeen days later, over 20 Inter-factory Founding Committees of independent trade unions merged to form one national organisation – *Solidarność* or Solidarity. This would prove to be one of the pivotal moments in the history of the Cold War.

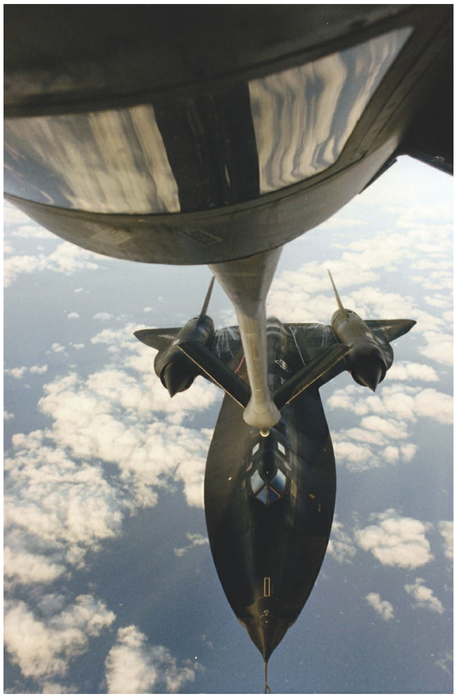
On 12 December 1980, a third SR-71 deployment to Mildenhall occurred. This time the JCS directed that the deployment should take place in response to a request from the Commander-in-Chief Atlantic (CINCLANT), who was concerned by the possible intervention of Soviet military forces to quell rising dissent in Poland. The Soviet track record of handling pro-Soviet governments at risk of falling wasn't good. In both Hungary (1956) and Czechoslovakia (1968), troops were sent to crush the uprisings. Western fears that Poland could face a similar intervention under the guise of a planned Warsaw Pact exercise were further reinforced on 8 December 1980 by the call-up of military reservists. In response, Captains Rich Young and Russ Szczepanik flew '964 on an HRR/ELINT mission into the Baltic and along the Polish coast on their inbound leg to Mildenhall. Their 'take' helped to verify that the exercise was indeed just that and not a precursor to military intervention. This deployment proved to be a milestone, with the aircraft staying in the UK for four months; it was replaced the day before its return to Beale by '972 on 6 March, which in turn stayed for two months, eventually departing on 5 May 1981 as Yappy 22.

17964
U.S. AIR FORCE
964

In response to social unrest in Poland, Capts Rich Young and his RSO Russ Szczepanik deployed '964 to Mildenhall via the Baltic to monitor a possible Soviet intervention. (Bob Archer)



Planned as a round-robin flight from Beale, ‘964 was forced to divert into Bodø, becoming the first SR-71 to land on mainland Europe. When fixed, it was repositioned and operated from Mildenhall. (Paul Crickmore)



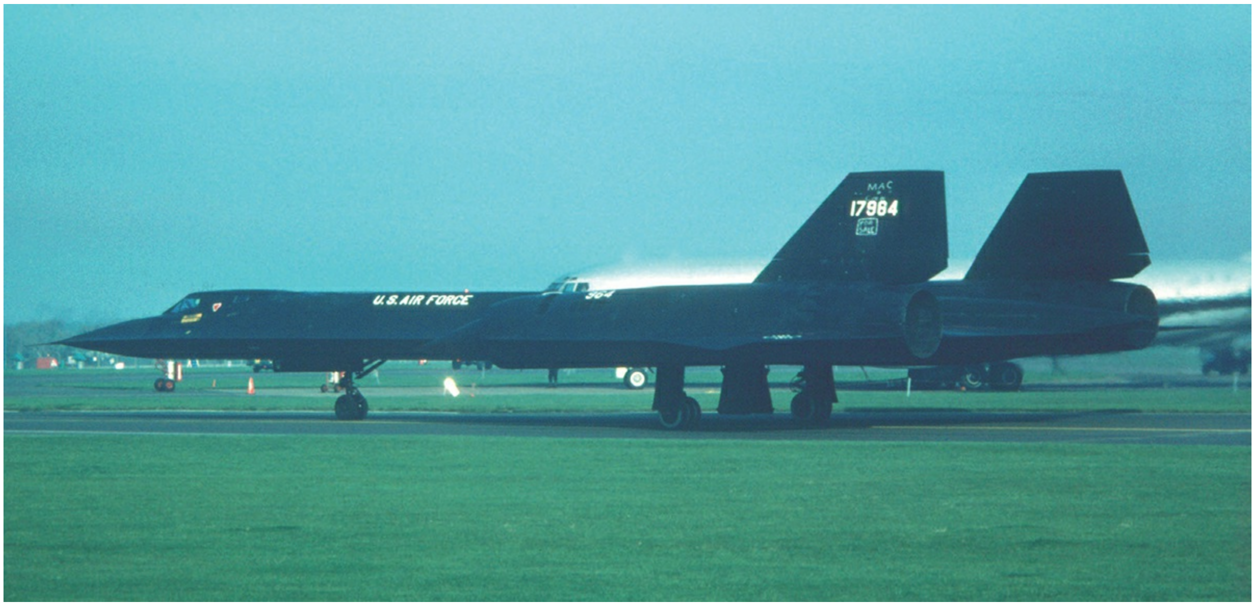
‘964 approaches the tanker boom to take on a split load of fuel during an operational mission into the Barents Sea on 6 October 1981 to monitor the Soviet Northern Fleet. (Paul Crickmore)

U.S. AIR FORCE

Tanks now full – see fuel streaking from leaking tanks – ‘964 side-slips right before accelerating away from the KC-135Q tanker. (Paul Crickmore)

By early December 1981, the political situation in Poland had continued to deteriorate as the clamour for reforms and democracy gathered momentum. Late on the night of 12 December, the situation reached breaking point and the communist leader Gen Jaruzelski cut all communication links with the West and deployed troops and armour to set up road blocks and occupy strategic installations. He then declared a state of martial law and appeared on television to announce the formation of a military Council of National Salvation. He claimed that strikes, protest demonstrations and crime had brought the country ‘to the border of mental endurance… the verge of an abyss’.

Two days later at least 14,000 trade union activists had been rounded up and arrested; seven had been shot in the Selesian coal fields while resisting Marshal Law. Would Jaruzelski turn to the Soviet Union for military help in his struggle to retain control of Poland? The Reagan administration needed rapid clarification of the situation on the ground to help in the decision-making process as to how they should respond. As ever the Senior Crown programme was on hand to collect vital reconnaissance data that would help support the process.



Photographed on 6 November 1981 prior to Majors Bob Crowder and John Morgan returning ‘964 to Beale, note chalk ‘re-serial’ to ‘984’ and the graffiti ‘MAC Crew’ and ‘For Sale’. (Bob Archer)

Major Nevin Cunningham had an opportunity to have an inadvertent quick air-to-air look at an Il-20 ELINT Coot whilst flying ‘958 on 15 December 1981. (Swedish Air Force)

On 15 December 1981, Majors Gil Bertelson and Frank Stampf were on the roster for this important sortie. The significance of their mission dictated that it was to be backed up with a spare aircraft; Majs Nevin Cunningham and Geno Quist (known within the crew force as ‘Neno’ and ‘Geno’) were suited up as spares. As Gil and Frank disappeared in their SR-71 into the cold, wet night, Nevin and Geno waited at the end of the runway in '958 for the code words that would either send them back to the barn or on their way on a long mission over much of the North Atlantic and northern Europe.

Soon after, Frank called back to Geno on their discrete HF radio frequency, saying simply, 'You guys have got it'. To which both spare crewmen simultaneously said 'Oh shit,' and off they went. The weather in the first air refuelling area over Nevada and Utah was so bad that it was all the Habu crew could do to find the tanker in the thick clouds. When they finally located it, and were on the boom, it proved extremely difficult for Nevin to maintain the connection due to the heavy turbulence. The updrafts bounced the KC-135 all over the sky to the degree that its autopilot was unable to react fast enough to the unstable conditions. This refuelling was therefore one of the most difficult experienced by both the tanker and SR-71 crews. Nevin asked the tanker pilot to forget autopilot and 'go manual' to achieve a better offload platform. Meanwhile, the transfer operation was enshrouded in Saint Elmo's fire, which lit up both aircraft like glowing Christmas trees.

After finally completing what Nevin described as a 'ragged refuelling operation', he lit both burners and pressed on to the second ARCP over maritime Canada. Again, the weather did its utmost to make the operation as uncomfortable as possible. After quickly crossing the Atlantic, they headed towards their third refuelling track off the west coast of Norway. Here they were sandwiched between layers of cloud, but the air was smooth in the Arctic twilight and the top off went smoothly. The long Atlantic crossing required a split off-load from two tankers. After taking half of his load from one KC-135, Nevin looked for the other tanker. As he closed in on the second aircraft, he discovered he was joining up with a Soviet Ilyushin Il-20 'Coot' ELINT aircraft! Nevin flew '958 up to the would-be tanker, its crew no doubt equally startled by the presence of a mysterious Habu.

The SR-71 was an excellent 'Agent Provocateur', stimulating Soviet weapons systems to come online, enabling NATO ELINT platforms to 'hoover up' the electronic data – a case in point is this Nimrod R. Mk 1 WX 665 of 51 Sqdn. (Swedish Air Force)

Nevin and Geno quickly dropped back and found the second tanker. After they topped off, the pilot lit the burners for the next high-hot run. At 72,000ft they headed into the take area, where it was especially dark at altitude (it seemed that the only source of light was from the two J58 afterburners 100ft behind them). Having completed an inner loop around the Baltic Sea, they were on their way back down to the fourth refuelling when the sun popped back up over the horizon.

To further complicate matters on this long and difficult mission, Geno was unable to make radio contact with the tankers. Fortunately, Nevin spotted contrails well below and ahead of them, and simply followed the aerial 'railroad tracks' for a join-up. While on the boom, Geno broke further bad news to Nevin that their astro-inertial navigation system had failed. Clearly it would not be possible to return to Beale, since ANS failure was a mandatory abort item.

They therefore settled into formation with the tankers, which led them to Mildenhall, where snow and ice covered the runway and taxiways. Finally, after what had turned out to be a very entertaining mission, ’958 slithered to a halt outside the dedicated SR-71 barn, and Nevin and Geno climbed out after their 8½-hour sortie – their 27th together.

Back at Beale AFB, the Californian weather was less severe. As BC Thomas and Jay Reid climbed from the tandem cockpits of a T-38 on completion of a routine training flight on Wednesday 16 December, they were met by Col Randy Hertzog, the wing DCO. He instructed them to go home and grab whatever they needed for an indefinite deployment to RAF Mildenhall. The KC-135 carrying both them and a maintenance team departed Beale at 7:30pm and arrived in England at 07:30am the next morning.

Nevin and Geno flew aircraft ’958 on a second sortie around the Baltic on 18 December, and another mission was planned for BC and Jay as soon as they were crew-rested from their transatlantic ride. An analysis of Geno’s take had revealed that the Soviet Union was not making preparations to intervene militarily to quell Poland’s political unrest. Consequently, on Monday, 21 December 1981, BC and Jay departed Mildenhall in ’958 and headed out over the North Sea for the first of five air refuellings. Their flight was tasked to monitor the Soviet-Polish border situation from a stand-off position in international airspace over the Baltic Sea, and to include a long northern run around the coast of Norway along Russia’s north coast. Jay activated the sensors as they cruised at Mach 3 on their northern loop, which exited the take area near Murmansk on a westerly heading toward the fourth refuelling. Out over the North Atlantic, the right generator cut off, but BC managed to get it reset.

After the fifth tank near Goose Bay, Labrador, another problem arose that would limit their cruise speed inbound to Beale. During acceleration BC noted that ’958’s supply of liquid nitrogen had been depleted, and that the fuel tanks could not be pressurized to inert the fuel fumes at high Mach. He limited the cruise Mach to 2.6 in accordance with emergency operating procedures and made his final descent into Beale somewhat low on fuel after a flight of almost ten hours. The series of Baltic sorties not only obtained invaluable intelligence at a time of high international tension, but also vividly demonstrated US resolve to stay actively engaged in the situation by using its key surveillance assets in the NATO–Warsaw Pact theatre of operations.

DIVERT TO ANDOYA

On 1 February 1982, Maj Rick McCrary and his RSO Maj Dave Lawrence were tasked to undertake a Barents PARPRO mission from RAF Mildenhall in ’980, as he describes.

It consisted of three ARs, a ‘buddy refuelling’ launch with one of our KC-135Q tankers followed by acceleration and climb to altitude heading north for AR2 with a trio of our tankers off the Norwegian coast followed by another accel to speed and altitude for reconnaissance off the northern coast of Russia. We would then return to the tankers for AR3 for subsequent activity and return to Mildenhall.

The time of year and northern latitude meant that much of the operation would be in reduced light. After completion of AR2 we began our acceleration and climb to Mach 3.0 and 70,000ft. As I reduced throttles to level off, an engine fire light illuminated. I retarded the throttle to mil power and the fire light went out, so we completed the checklist and began a wide, descending left (westerly) turn away from the denied area, to our briefed emergency base at Royal Norwegian Air Force base Bodø, in Norway.

Dave began communications with the tankers and command post, while I talked to ATC to alert them of our plan. We began dumping fuel to achieve a safe landing weight when ATC notified us that Bodø was closed for weather and that the only open military field was RNAF Andoya about 250 miles North of Bodø. Andoya was a ‘bare bones’ RNAF P-3 operating site, located on the coast and not operating at that hour, but would accept us.

The airfield had a NATO standard 8,000 x 150ft runway, and as we continued to dump fuel it sounded like our best option. The weather was just above the 200ft ceiling and half mile visibility as required for ILS minimums with a snow packed runway. I asked for the braking condition, and while the numerical system was different to what we use in the US, the controller said it was 60 per cent of spring condition. When I asked for clarification, he indicated it was acceptable for their military aircraft although he probably was not used to our final speed of 175kt and landing at 155kt.

Breaking out of the clouds at about 250ft I could see a hangar to our left and runway lights in the snow outlining the runway. As soon as I crossed the threshold, I pulled the drag chute handle which deployed about the same time I ‘planted’ the main landing gear on the ground. I carefully applied braking and fortunately got good traction, and we slowed quickly in the snow. Fortunately, my previous assignment was flying the FB-111 at Pease AFB, New Hampshire and I had operated in heavy winter conditions.

‘974 is pictured getting airborne from Det 4 on 5 May 1982. It was forced to abort into Bodø after completing ‘the take’ during this mission due to an oil quantity issue. (Lindsay Peacock)

Ground crew move wheel chocks into position prior to the pilot undertaking final engine checks shortly before another Det 4 ops mission gets underway. (Kevin Gothard)

We taxied\slid into the only hangar which the RNAF had quickly emptied, and proceeded with engine shutdown and exit. The base commander was there to greet us and asked what we needed which was security for the aircraft, a telephone to contact Mildenhall, and a beer. They graciously provided everything we needed including flight suits and the warm woollen long-johns their aircrew use.

> Mildenhall launched a maintenance crew [that included Lockheed Field Service Rep Ray Troll] that night who landed in their KC-135Q in those same conditions and began their assessment. An engine swap was required, and as the massive J-58 on its stand would not fit in a '135, a C-141 was arranged the next day to bring one in from Mildenhall. The maintenance crew did their magic and '980 returned to England 3 days later and continued operational activity. The intensive training we had received paid off big time!

Det 4's capability was doubled during the closing stages of 1982 when two SR-71s were stationed at Mildenhall for the first time. Aircraft manning was accomplished by a number of crews on Temporary Duty (TDY), 30-day deployments and flying a succession of 'routine but highly productive missions' across the North Sea and Eastern Europe. As '972 had been deployed for seven months, it was ready to be returned to Beale for periodic heavy maintenance, which included replacing fuel tank sealant.

61-7972 deployed to the UK on no fewer than six occasions between September 1974 and July 1983. It is seen here sporting low-visibility markings during its final deployment to Det 4, which ran from 18 December 1982 through to 6 July 1983. (Paul F. Crickmore)

Pictured on 29 December 1982, Majors Rich Judson and Mac Hornbaker had ferried '971 into Det 4 six days earlier. (Lindsay Peacock)

Majors Les Dyer and Dan Greenwood are pictured on 2 February 1983, departing Det 4 in '971 (Lindsay Peacock)

During a mission to gather reconnaissance around the Barents on 7 May

1982, Maj BC Thomas and Maj Jay Reid got a low oil quantity reading for their number 2 engine shortly after clearing the collection area. It was almost a carbon copy of what they'd experienced in '964, nine months earlier. As this was a mandatory abort item on the checklist, they were once again forced to divert, this time with '974, into Bodø. The next day a maintenance team headed by Tony Chiappetta duly arrived from Mildenhall. All systems were thoroughly checked and signed off, after which BC and Jay completed the 2 hours 30 minutes subsonic flight back to Mildenhall on the 9 May.

Nevin and Geno got the big redeployment sortie back to Beale and left Mildenhall in '972 at 10:00am on Tuesday 5 July 1983 via the Barents/Baltic Seas. After completing their first take run on a northern loop over the Barents Sea, they decelerated into the Viking North air-refuelling track in international airspace west of Bodø, Norway. Topped off, they climbed back to altitude and entered their second collection area, within the narrow Baltic corridor, to complete the reconnaissance portion of the mission. Preparing to head home, they again decelerated and descended into the refuelling area over the North Sea. Back at high altitude, Geno calculated that Nevin would have to accelerate to maximum Mach to improve the aircraft's range to ensure they would have enough fuel to reach the next set of tankers near Labrador.

During this high-hot phase of the flight, the left engine's EGT became uncontrollable, with indications that '972 should not be flown faster than 3.05 Mach to ensure engine damage would not occur. By flying at this less than optimum speed, the SR-71 would not be able to reach the KC-135s. Taking manual control of the inlet spikes and doors would have made matters worse since it lacked the precision of DAFICS and they would only be able to maintain Mach 3 in that configuration. Another alternative, slowing to subsonic speeds, would exacerbate their low fuel predicament even further and they also found they could not get back to Bodø. Therefore, they had to press on toward their tankers in the hope that they might be able to improve their fuel flow rate or to divert into Iceland. For the next 45 minutes Nevin flew at 3.09 Mach before slowing to 3.05 to allow the EGT to drop back into the 'green'.

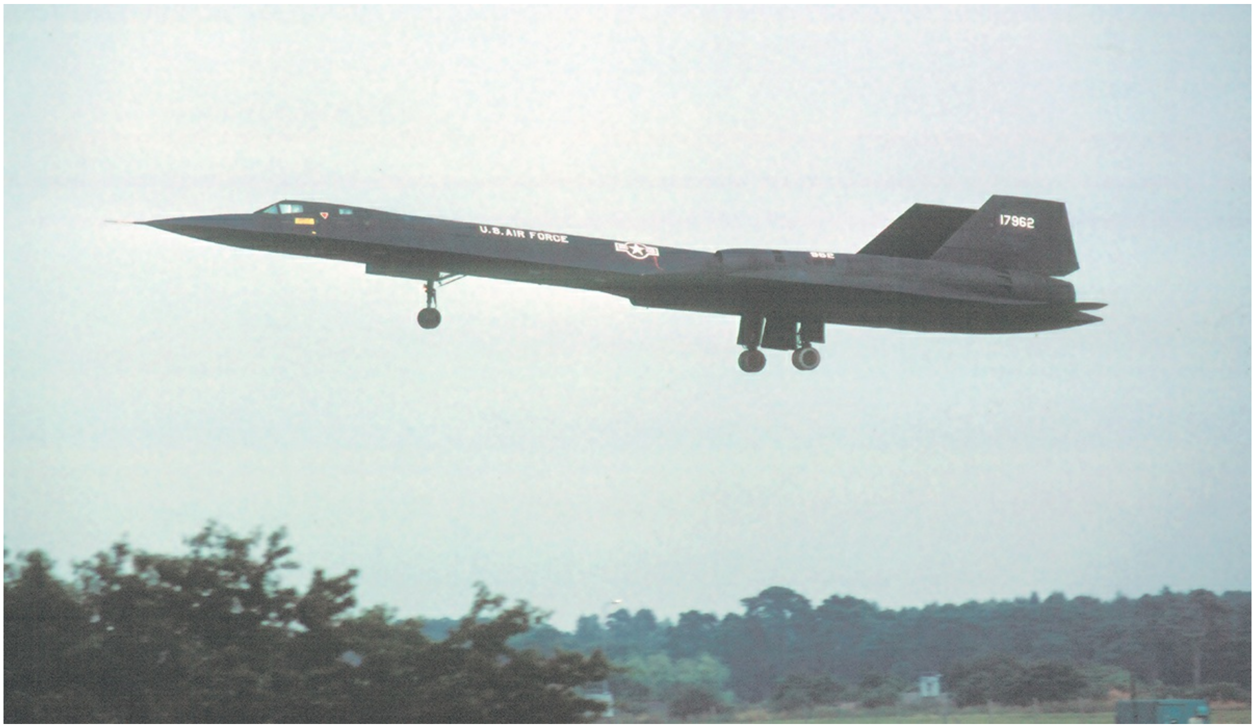
As they approached the 'point of no return' off Iceland, Geno recalculated the fuel situation, which had improved slightly. Nevin decided to press on and told Geno to get the tankers to fly towards them to further shorten their distance to hook up. After completing their hook-up in record-breaking time (to their great relief), the fuel streamed into '972 at more than 6,000lb per minute. Back at

Beale after another seven hours of SR-71 excitement, neither crewmember would admit to how much (or how little) fuel they had remaining before they made contact with their everlasting friends in the tanker.

AIRCRAFT NUMBER '955

In May 1983, it was decided by HQ SAC and Air Force Systems Command officials to demonstrate Loral's Advanced Synthetic Aperture Radar System (ASARS) on an SR-71, before upgrading the rest of the Habu fleet with this new high-definition ground-mapping radar system. After aircraft number '955 was equipped with the new system, BC Thomas and John Morgan were assigned the task of conducting the first operational test flight. On 1 July 1983, they made SAC's first ASARS familiarization flight, which lasted just over 5 hours, during which John learned ASARS 'switchology' and operating techniques. Five days later Maury Rosenberg and Ed McKim also flew the modified SR-71 on a 5-hour sortie, recovering into Beale AFB rather than Palmdale. On 9 July, Maury and Ed deployed '955 on a 7-hour flight to Mildenhall, via the Barents collection area.

BC Thomas is seen at Palmdale readying ‘955 to position to Beale – after which it would embark upon a classic piece of deception. (USAF)



Don't believe all you read… Captured on finals, '61-7962', flown by Majs Maury Rosenberg and Ed McKim, prepares to land at Mildenhall on 9 July 1983, having flown in from Beale via the Barents/Baltic Seas collection areas. In fact, the aircraft displays a false serial applied to 61-9755 for a classified ASARS operational evaluation. (Bob Archer)

British plane spotters, peering through binoculars and telescopes from various off-base vantage points, excitedly recorded the Habu's arrival, some noting the slightly bumpy ASARS nose, but a familiar tail number. On that occasion, all of them logged a false serial, since a cover number was being used to conceal the fact that the 'test bird' was overseas. As '955 was already known by military aviation enthusiasts as 'the Palmdale test-ship', it had been decided by the maintenance folks back at Beale to temporarily rechristen '955 as '962 for this deployment. The latter jet had visited Mildenhall earlier, and would not draw unwelcome attention and speculation to the unique test deployment.

Nine days later, on 18 July 1983, BC and John took the aircraft on a 2.6-hour ASARS operational test sortie to monitor military installations in East Germany. However, the mission was of only limited success as both the ASARS and INS malfunctioned. The system worked well on 21 July, when Maury and Ed took their turn on a 4-hour mission. On entering the Baltic Maury recalled Ed saying he'd 'never seen so many radars painting', as they flew through the area.

The next day BC and John flew ’980 to the International Air Tattoo at Greenham Common, to help raise money for the RAF’s Benevolent Fund. Among the many thousands of people who came to see the aircraft were some of the ‘Greenham Women’, who had long been demonstrating against many political issues, and who had been camping outside the base to gain public recognition. The day before the SR-71 was due to return to Mildenhall, some of the demonstrators managed to daub white paint on the Habu. They were quickly arrested for causing a disturbance and for possible damage to the aircraft’s titanium, which later laboratory analysis proved was unharmed.

Several days later, Maj Jim Jiggens and Capt Joe McCue performed an unforgettable departure from the base. After a morning take-off on 26 July for the short flight back to Mildenhall, Jim (an ex-Thunderbirds display demonstration pilot), who had obtained prior permission from the base commander to do a farewell flyby, flew a wide circular pattern at 250kt towards the Greenham Peace Camp. As ’980 reached a strategic point, Jim pushed both throttles to full afterburner, whereupon the SR-71 thundered over the encampment at a very low altitude. Applying sharp back pressure to the control stick and lofting the Habu into a spectacular climb, Jim allowed his sleek aircraft to trumpet the ‘sound of freedom’ as only an SR-71 could.

The final ASARS operational demonstration flight was conducted on 29 July, when BC and John flew ’955 on a 7.3-hour flight back to Beale via the Barents Sea. The tests were extremely successful, proving that ASARS represented a quantum leap in radar resolution and capability for reconnaissance gathering purposes. Captains Gary Luloff and Bob Coats ferried the aircraft from Beale back to Palmdale on 2 August, where further tests were conducted prior to an initial order for two production radar sets for the operational fleet. ASARS imagery reduced resolution down from about 5ft at nadir to 1ft. According to SR-71 pilot and squadron commander Lt Col Rod Dyckman,

> When the ASARS was introduced, a new level of activity opened up for the SR-71. ASARS produced far better results than the HRR and worked during all normal SR-71 flight attitudes, unlike the HRR that cut out during turns [a feature particularly useful when imaging the Northern Fleet’s sub pens, within the tight geography of the Barents Sea]. In addition, a night schedule also came with the introduction of the ASARS…

This new advanced system generated a commensurate increase in requests for

SR-71 operational missions to be flown to support the intelligence needs of the USAF, US Army and especially the US Navy.

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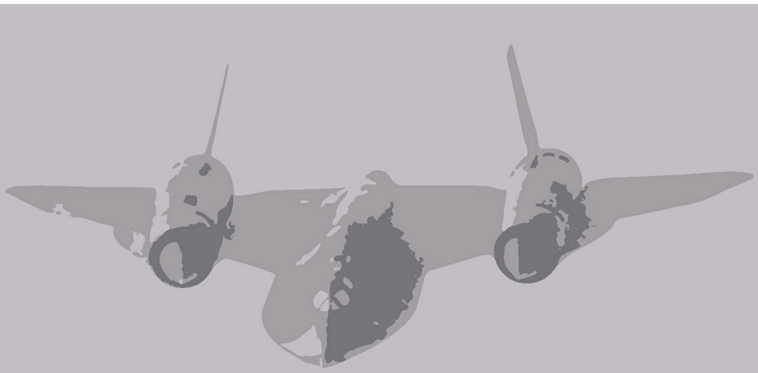
Having been daubed with white paint by Greenham Common Peace Protesters, Majors Jim Jiggens and Ted Ross positions '980 back to Mildenhall after first providing them with an exceptionally low, ear-bursting low-pass. (Bob Archer)



CHAPTER 16:
DET 4 AT PACE

17958
U.S. AIR FORCE
958
USAF

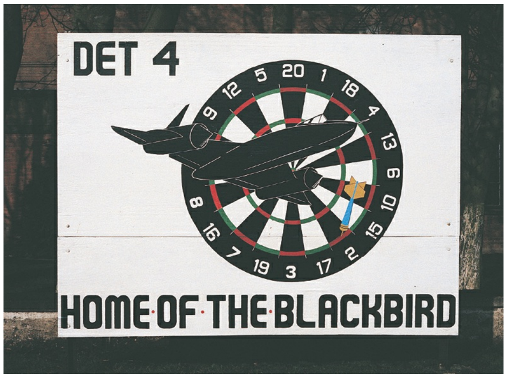
A devastating bomb attack on a US Marines barracks in Lebanon resulted in Det 4 being tasked by the US national leadership to dispatch an SR-71 (‘958), to the region on 24 October 1983 to ascertain if large-scale ground actions were likely to follow. (Lockheed Martin)

PERMANENT DEPLOYMENT

Although the 1983 deployment to Mildenhall was still called a 'temporary operation', two SR-71s remained at the base for almost the entire year (apart from a period lasting 33 days early on, and three days in the autumn). As early as 1980, SAC had begun planning changes in the SR-71's European operations to cut the cost of deployments and increase the frequency of surveillance flights. Such changes required actions of 'air diplomacy' on the part of HQ 3rd Air Force, and USAF and SAC staff specialists. On instructions from the JCS, HQ USAF and HQ SAC, Col Don Walbrecht of the Third Air Force (accompanied by Lt Col John Fuller and Lt Col Dwight Kealoa of HQ USAF/XOXX and Lt Col Kenneth Hagemann of HQ SAC/XP) proposed to Assistant Secretary Martin Scicluna, and to Gp Capt Frank Appleyard, Deputy Director of Operations in the RAF's Directorate of Organization (DGO/RAF) that SR-71 operations at Mildenhall should be bedded down on a more permanent basis.

Scicluna (head of the MoD's 5-9 (AIR)) led the British contingent that reviewed the proposal. Although he thought that the SR-71's high visibility image might cause 'political difficulties' at some senior levels, he took the issue forward to Secretary of State for Defence Sir Francis Pym, who agreed to consider it. After specialized briefings to a few MoD insiders, which included certain intelligence officers who had special access to US reconnaissance information, recommendations were taken to Pym, who agreed to the initiative. Another meeting held three days later worked out the politics of the proposal.

The following week, each member of the US team briefed his respective CINC or Deputy Chief of Staff at Ramstein, Omaha or Washington that the programme was on track in Whitehall. Soon after, Prime Minister Thatcher's approval was noted as a simple 'change of mode of operations' from temporary deployments to a permanent presence at RAF Mildenhall. U-2 operations were to be moved from Mildenhall to Alconbury as both bases were beefed up for their expanded intelligence roles.



On 5 April 1984, Prime Minister Margaret Thatcher announced that a blanket clearance to operate two Habus from the United Kingdom had been granted. Since Det 4 was now solely an SR-71 detachment, the change was reflected in its redesigned insignia. (Paul Crickmore)

During the next two months, Walbrecht made regular trips to London to answer questions from MoD officials who prepared authority documents for ministerial signature. Scicluna later confided that the SR-71 initiative went down very well because of long-standing intelligence sharing connections, and because one of his junior staff officials had suggested calling the proposal a simple ‘change of mode’ of current operations from intermittent to permanent basing. The permissive loop was then closed, and the SR-71s could come to England, where they would remain the plane spotters’ favourite attraction for many years.

On 5 April 1984, Prime Minister Thatcher announced that a detachment of SR-71 aircraft had formed at the Suffolk base. A blanket clearance to operate two Habus from the United Kingdom had been granted by the government, but certain sorties would still require prior high-level approval from the MoD. Moreover, those especially sensitive operations would require a clearance from the PM herself.

LEBANON

By the mid-1970s, the complicated politics that had bonded Christian and Muslim factions together in relative peace in the Lebanon since it declared independence in November 1943 had broken down. Thereafter, a long and tragic civil war erupted, fought by multiple groups that was further complicated by the wider implications of the region's power politics. By 1982, despite an intervention by Syria, the loss of life had reached many thousand dead on all sides of the rising conflict.

The situation in southern Lebanon was further exacerbated by terrorist organizations, sympathetic to the Palestinian cause, periodically launching attacks across the border into neighbouring Israel. These acts became progressively more numerous and violent. After several retaliatory strikes, Israel responded on 6 June 1982 with a full-scale invasion, aimed at destroying the Palestine Liberation Organisation (PLO) leadership and its armed forces. Twenty-three days later, Israeli troops were at the gates of Beirut and in a position to fulfil their objective. However, Israeli Prime Minister, Mechachem Begin was forced to modify his fierce demands in the face of threats by the Soviet Union to aid Syria and US disapproval of his invasion. The Israeli siege of Beirut ended with 7,000 PLO fighters abandoning the city and fleeing the Lebanon into sympathetic Arab sanctuaries in Syria, Jordan, the Sudan, North and South Yemen, Algeria, Iraq and Tunisia – where their leader, Yasser Arafat, set up his headquarters.

On 28 September 1982, President Reagan announced that the US Marines were to resume their peacekeeping role in Beirut, which had been interrupted by the Israeli invasion. Reagan said he believed it was important that the US maintain a military presence in the area until the Lebanese government was in full control. France, Italy and the United Kingdom also dispatched peacekeeping troops to the region. However, fighting between competing militias escalated in the wake of the Israeli withdrawal and violence against the multinational force increased, with US Marine positions routinely coming under small arms and mortar fire. Circumstances took a crucial turn for the worse, however, when US ships in the Mediterranean shelled Syrian-backed Druze militias, in support of the Christian government. This resulted in the perceived role of the multinational force shifting from non-aligned to the active support of a particular faction in the civil war.

On 18 April 1983, a suicidal member of Islamic Jihad, a pro-Iranian network of fanatical Shi'ites, drove a truck loaded with 300lb of explosives up to the entrance of the US Embassy in Beirut; he detonated it, killing 40 people, including eight Americans. Six months later, on the morning of 23 October 1983, a coordinated attack was executed by two truck-driving suicide bombers. The first detonation (estimated to consist of 12,000lb of explosive), ripped apart a four-storey building that was being used by the US Marines as a barracks in Beirut – it killed 241 Marines and sailors, making it the worst loss of life suffered by the corps since the battle of Iwo Jima in 1945. Just seconds later, a second suicide truck-bomber detonated his deadly cargo within the confines of a French parachute regiment barracks. The explosion toppled the building and killed 58 soldiers.

In a situation reminiscent of the 1973 Yom Kippur War, there were no US reconnaissance satellites in the required orbit that could provide national decision makers with the vital intelligence required to make pivotal, military and foreign policy decisions. Once again it fell on Senior Crown to provide the requisite hot-spot surveillance, as Dave Peters describes:

Major Dave Peters (facing camera) and his RSO Ed Bethard converse after a mission. They were airborne from Mildenhall in '958 in a little over just 24hrs after the truck-bomb attack. (USAF via Dave Peters)

> In October 1983, my RSO Ed Bethard and I were TDY at Det 4. After the terrorists struck the marine barracks in Beirut, Lebanon, Ed and I got a call from Jay Murphy, the Det 4 Commander to get down to see him. When we arrived, we were briefed on the situation and since we were next crew on the ladder, we would be flying the mission. The US intelligence net were working in the dark and from what we could gather, they weren't sure what had happened. But since it was such a huge incident, they were concerned about the overall consequences – as was President Reagan. They wanted us there as soon as possible to get an overview to determine if there was evidence of a much larger meaning to it.
>
> The request was for a daylight, visual surveillance mission, which required the aircraft having a nose change from our usual configuration of the CAPRE (radar) nose, to the OBC (Optical Bar Camera) nose, as well as prepping the airplane for an unscheduled mission. The maintenance guys got to work and the airplane was ready to go the next morning [24 October]. The usual turn time for this would be 24 hours.
>
> In the meantime, Ed and I got briefed with everything that was known and what we were to

accomplish. The thing that made it highly unusual was that President Reagan, working through the State Department, was trying to get us clearance to overfly France. This would save us hours and tankers to get the mission done. If we could not go that route, we would have to fly all the way around Spain and into the Mediterranean Sea through the Straits of Gibraltar – which would require multiple refuelling. We planned the mission to overfly France as it would take another day to get tankers set up and in place.

To fly the mission as planned, we would take off with a yo-yo fuel load and go directly to the target area supersonic, do the required passes and then descend north of Crete, to get enough fuel to get back to England. Once we were ready, it was a case of waiting for the 'Go' word.

Apparently, the French were as apprehensive as us about the big picture, because this was one of the very few occasions that they gave us permission to overfly. Ed and I suited up and took off in '958, late morning. It was a great day for Europe in late October, and we went straight to Mach 3 and about 75,000ft. We proceeded directly to France, coasting in a little south of Normandy, crossing south of Paris, and entering the Mediterranean over Nice. We accelerated to Mach 3.2, flew our west-to-east pass, turned and made a north-to-south pass, going across to Libya and Kadaifi's 'valley of death', before heading to Crete to let down for fuel. Once fuelled up, we returned across France, landing back at Mildenhall.

Surveillance of Lebanon continued on 4 February 1984 when '974 was directed to the region. (Kevin Gothard)

17974
U.S. AIR FORCE

Majors Bill Burk (pictured) and his RSO Tom Henichek flew the 4 February mission. (Bill Burk)

Ed and I both had some observations about the mission. First, it was eerily quiet. We had all our

DEF systems on the whole way through and never got a single look. We felt we'd get tracked if not shot at, especially during our little foray into Libya. The weather was beautiful and we got a great look at many things we'd not seen before. Everything worked perfectly.

Once back at Mildenhall, we'd not been out of debrief for more than an hour when one of the recce tech guys (our photo folks) called and asked Ed and I to go over. That was unusual, as we hardly ever got to see 'the take'. They showed us beautiful shots of four Lebanese Air Force aircraft, parked on a road north of Beirut.

A really interesting aside here is that Ed has since become friends with a fellow from Lebanon who has become a US citizen and his father was the commander of the Lebanese Air Force at the time of our mission.

I guess the bottom line of it all is that while the attack was a true catastrophe, our mission established that it wasn't a prelude to something bigger, as was feared. To the best of my knowledge, this was the only SR-71 mission that was ever authorized to fly through France. But the real focus of the story should be on the amazing support and maintenance, intel, planning staff and our incredible tanker folks, who got this mission accomplished under such a pressure situation.

We did that little turn through Libya, which was planned but not necessary. I believe that it was at President Reagan's request, to make a statement, 'We are watching you'. Later he instigated the bombing of Libya with the express purpose of taking Gaddafi out.

Majors Bill Burk (left) and Tom Henichek chalk up another Habu mission. (USAF) Portugal. About 150 miles from our entry to the Straits, Spain and Morocco became clearly visible defining the entry point.

Another bombing, on 4 November, claimed the lives of 39 Israeli troops within their guarded camp. By early 1984, the peacekeeping position had become untenable and the troops were withdrawn, leaving behind only the Syrians and the Israelis. By February, Lebanon was once again embroiled in an ever-worsening civil war.

Surveillance of Lebanon continued, but from hereon France refused overflight authorization, as Bill Burk recalls.

In February 1984, Lt Col Tom Henichek, my RSO, and I were flying Northern and Central Europe SR-71 missions out of RAF Mildenhall, UK. On 2 February our detachment at Mildenhall received Joint Chiefs of Staff tasking to photograph the entire country of Lebanon, and specifically Beirut.

Mission planning and prepping aircraft 61-7974 was accomplished on February 3, with take-off scheduled early on the morning of 4 February. We were not given overflight privileges by the French government, so our flight profile was to refuel off the south coast of England, fly a Mach 3 cruise leg down the coast of Portugal and Spain, left turn through the Straits of Gibraltar, refuel in the western Mediterranean, fly a supersonic leg along the coast of Greece and Turkey, right turn into Lebanon and down main-street Beirut, exit along the southern Mediterranean with another refuelling over Malta, then supersonic back out the Straits and return to England.

The first refuelling over Land's End, UK, was a bit challenging as we were in total IFR (Instrument Flight Conditions) in rain showers. After receiving a full on-load, we waved goodbye to our KC-135 tankers and headed south to the entry point for the Straits of Gibraltar. As we climbed to our initial level off at 73,000ft and Mach 3, the weather cleared beautifully and gave us an awesome view of Western France, Spain, and

The second refuelling went as briefed and we climbed to 76,000ft and Mach 3+. Climbing eastbound and crossing the southern coasts of Italy, Greece, and Turkey, our right turn southbound to line up with the west coast of Lebanon gave us great views of our target area. The pre-take-off intelligence briefing had warned us that Russia had positioned an SA-5 missile system just west of Damascus, Syria, which we would be penetrating (we were unsure of Syria's intention in this whole conflict). Because the SA-5 was one of the few threats to the SR-71, this part of the mission was designed at Mach 3+, and above 75,000ft. As we entered Lebanon, Tom advised me the defensive systems showed tracking by the SA-5. Seconds before this Tom advised me that an Arabic voice was on 'Guard' frequency (monitored by all aircraft) and that it was likely they were alerting their forces of our presence. About 15 seconds later we received warning of active guidance signals from the SA-5. Unfortunately, we could not tell whether there was an actual launch, or the missile was still on the ground rails just being fed active tracking of our aircraft. We climbed above 80,000ft and had the SR Mach pegged but we did not turn off course. We both decided the mission was too important and without visual conformation of launch, we were not about to abort. Believe me, we were looking very hard for the contrails of a possible missile launch!

After our pass across Beirut, we had completed the right turn toward Malta when I received a 'Low Oil Pressure' warning light on the right engine. SR-71 crews learn after a while that any time you take the aircraft up to max Mach you heat the aircraft systems to such a degree (due to skin friction) that temperature-related problems are quite common. Some are real and some are false alarms. We decided to slow the aircraft and descend into the refuelling track. While I got on the boom of the KC-135Q to refuel, Tom was busy sending out classified radio codes on HF radio advising authorities that we had completed the intelligence collection successfully and we were experiencing an aircraft emergency and would be diverting to our planned divert base and landing shortly. The warning light was still on, so we took on enough fuel to recover into Sigonella, Italy. As we were on left downwind for landing, sure enough, just as we suspected, the aircraft cooled down enough that the engine warning light extinguished. The oil pressure had been normal all along and the engine was running okay, so, much to the dismay of Sigonella approach, we cancelled IFR, climbed to 20,000ft and rendezvoused with our tankers. Tom and I decided not to tempt the gods by taking the aircraft supersonic, and that a subsonic return to England was preferable. We could make it back to England subsonic fully fuelled, but only a direct flight back… we couldn't fly our planned route back out the Straits of Gibraltar. While I took on a max fuel load, Tom copied the tankers' route of flight back to England, and advised our command on HF radio that we would be returning to Mildenhall, subsonic.

We climbed up to 26,000ft and cruised at 0.9 Mach. We had no IFR clearance, but after departing the tankers we did finally establish contact with Italian and French controllers. Tom was extremely busy trying to keep us on the flight plan that he had copied from the tankers' filed flight plan. In France they defined flight routes by using NDBs (Non-Directional Beacons) which meant Tom had to load the latitude and longitude for each beacon… no small task in a pressure suit!! As Tom was busy keeping us on track, I took the rare opportunity to relax and enjoy the view. The French and

Italian Alps were crystal clear and majestically covered in snow. We had a nice view of central France and the river Seine flowing through Paris. Meanwhile, the French air traffic controllers were constantly calling us trying to figure out who we were and every time they asked, we told them we were 'a US Air Force tactical aircraft with an emergency and we were proceeding direct to England'. We got away with this for quite a while until almost across France when Tom said to look out the left window. Sitting about 10ft on our left wing was a French Mirage III fighter. He came up on our radio frequency and asked us for our Diplomatic Clearance Number. I had no idea what he was talking about, so I told him to stand by. Asking Tom if we had such a thing, he told me, 'Don't worry about the clearance number, I already gave it to him.' I asked Tom what he meant, and he said he gave the fighter the international signal for non-compliance, 'the bird!' Realizing that it was time to cut and run, I asked Tom how long to the English Channel and he replied 2 minutes. I lit the afterburners and headed for the coast. Our Mirage friend turned back at the Channel and we recovered uneventfully back at Mildenhall. The mission, if flown as planned supersonic, was scheduled to be 6 hours … we landed 8 hours and 15 minutes after we had departed.

Apparently, our cut across France had caused quite a stir because before we could get de-suited and into ops, the Pentagon was on the phone saying the State Department was upset. I told them we 'got the take' (photo and radar of Beirut), and the SR-71 was safely in the hangar, and we were headed for the bar! We had done our job, now let the diplomats go to work!

The intelligence objectives were to photograph the entire country of Lebanon, which we accomplished. In our post-mission intelligence briefing, when we mentioned we had collected over 5 minutes of active guidance from the SA-5, I swear the intel guys almost spilled their coffee as no one had ever collected active guidance from an SA-5… the most formidable missile in the Soviet inventory at that time. What a stroke of luck as the US and NATO could now develop a viable defence system for the SA-5 (this mission undoubtedly secured up to date ELINT about the SA-5 that was probably as significant to the NSA as the Spencer/Sheffield mission of 27 September 1971 – see Chapter 13). Tom and I visited the photo interpreters the next day and they showed us pictures of weapon caches stored in a soccer stadium in downtown Beirut, not visible on the ground as the stadium was elevated and hidden from view. What a satisfying feeling that Tom and I had gotten the SR-71 through another successful mission!

The SR-71 was an aircraft that demanded total concentration from its crew even when performing the most benign tasks, as Stormy Boudreaux recalls:

One cold morning at RAF Mildenhall in 1984, Ted Ross and I were taxiing out for take-off on Runway 29. From the hangars of Detachment 4 to Runway 29, there is a curving route called Taxiway Bravo. Along either side of Taxiway Bravo are parking aprons for tankers and other large aircraft. I was following the buddy crew leading us to the runway along a sweeping gentle left arc, gently riding the brakes because even on a warm day, the engines in idle thrust and unchecked by braking would allow us to settle into a steady-state speed of nearly 100mph, so we always were riding the brakes to keep the speed to the equivalent of a fast walk. Then as the taxiway path switched to a partial right-hand turn to roughly parallel the runway, with the nose-wheel steering engaged, I fed in a little right rudder, which should have turned the black jet to follow the right-hand turn. But nothing happened; we were continuing straight ahead. So, I pushed further and further on the right rudder pedal, but we are still going straight. Not that big a deal, since the brakes are independent. I pressed harder on the right-side toe brake, since we often augmented steering with differential braking. Each toe brake (right or left) was directly attached to the wheel brakes on the right or left wheel assembly. If I pressed harder on the right, it would swing the nose to the right. But all that happened as I pressed harder and harder on the right brake was that the anti-skid started cycling on the right side, and the aircraft was diverging from the painted center-line stripe, but the turn wasn't very sharp so this was a gradual departure from the course I wanted the aircraft to take. So, I started pressing on both toe brakes while holding full rudder to the right. The aircraft continued straight ahead with both the anti-skid systems cycling rapid fire. I could feel the pulsing through the airframe but the jet wasn't slowing down nor was it changing course. Directly in front of me was one of those large parking pads for tankers, and fortunately it wasn't filled with a tanker. However, what I soon noticed was there were some cones in the middle of the parking area that highlighted some construction work. That was why there was no tanker parked there. It soon became apparent that there was a deep trench, about 4 or 5ft deep and about 3 or 4ft wide, across the parking apron at 90° to my path. The SR-71 had 2 hydraulic systems for braking and steering. I switched from the primary braking and steering system to the back-up system, but all that happened was the anti-skid system continued cycling but not slowing the aircraft at all. Finally, I switched the anti-skid system off, shut down both engines that were pushing hard against the braking effort. I then pushed as hard as I could on both rudder pedals and even though I weighed about 125,000lb, the aircraft slid to a stop, with about 35–40ft to go to the trench! This all happened so fast that I didn't have time to tell anyone!

My actions flat-spotted all six main-gear tires down to the 'red-cord' that indicated when the tires were mandatory to be replaced. This meant all six needed replacing before another flight. Troubleshooting the system found absolutely no issues with the equipment and I flew the mission after a 24-hour delay. Later Lockheed engineering determined that the 29–31°C temperature with just a little moisture on the surface, together with the power of the idling engines, had created a situation where the nose wheel wasn't 'biting' into the turn when I turned the nose tire. The same conditions caused the anti-skid system to release the brakes, preventing differential braking or any braking at all until I turned the systems off.

In my mind's eye I envisioned the nose wheel entering that trench and I thought the egress from the aircraft wouldn't be too difficult because the bottom of the jet would be on the ground and there wouldn't be much of a jump from the cockpit to the ground if that happened.

SYRIA

The ability of the SR-71 to conduct short notice, hot-spot reconnaissance anywhere in the world was again implemented at 07:30am on 27 July 1984. Majors Stormy Boudreaux and Ted Ross departed Mildenhall in '979, using the call sign Boyce 64. This important flight to Syria (the crew's 30th operational mission together) was complicated by several factors: the usual refusal of overflight transit across France, which necessitated entering the Mediterranean area via the Straits of Gibraltar; inlet control problems during acceleration to high Mach, which forced Stormy to 'go manual' on bypass door operations; and spike control problems at 2.2 Mach, which further aggravated control.

Det 4 were again tasked to perform hot-spot reconnaissance of the Middle East when on 27 July 1984, Majors Stormy Boudreaux and Ted Ross flew '979 on a round-robin mission to Syria. (Curt Osterheld)

On 29 October 1984, Majors Joe Matthews and Curt Osterheld flew '962 on a Baltic/Buffer Zone mission. (Bob Archer)

By this time '979 was eastbound and nearing Mach 2.5, and the flightpath was committed to entering the Med on the pre-planned heading, or overflying West Africa or Spain during an abort. Consequently, Stormy elected to 'go manual' on both inlet spike and door operations. Emergency operating procedures dictated that an aircraft in a 'double-manual' configuration should not be flown above Mach 3 and 70,000ft. Therefore, Stormy held '979 at that degraded limit and pressed on through the Straits of Gibraltar, high over the Mediterranean. Off the southern coast of Italy, they decelerated and descended for a second refuelling. Standard procedures (once returning to subsonic flight) included resetting all inlet switches back to 'automatic' and to continue the next leg of the flight in 'auto', since such inlet glitches often cleared on another acceleration cycle.

Stormy and Ted followed this logical procedure, but '979 repeated the previous disturbances. At that point 'according to the book', they should have aborted the flight. The mission had been planned around a single high-speed, high-altitude pass over the target area. The well-seasoned crew reasoned they had already come so far that they could make that one pass easily and collect the needed reconnaissance data within imposed operating constraints, especially since they could easily break off over the waters of the Eastern Mediterranean should they have any serious difficulties over land.

They completed the recce run manually, but found that '979 (in the less fuel-efficient manual inlet configuration) ended the run in a notably depleted fuel state. Ted urgently contacted the tankers, which were orbiting near the island of Crete, and asked that they headed east to meet the thirsty Habu. As the SR-71 descended, Stormy caught sight of the tankers some 30,000ft below, and executed what he described loosely as 'an extremely large variation of a barrel-roll' and slid in behind them 'in no time flat'. The boomer plugged in immediately and '979 began taking on the much-needed JP-7. Hooking up well east of the normal ARCP, Boyce 64 had to stay with the tankers much longer than the normal 12 to 15 minutes of 'on the boom time' to drop off at the scheduled end-AR point before proceeding back to England.

With '979's tanks filled to a pressure disconnect, Stormy and Ted climbed to high altitude on the final leg back through the Straits of Gibraltar and home to Mildenhall, where they landed after almost seven hours, four of which had been spent at supersonic speed while carefully controlling inlet spikes and doors manually. The good news was that their take was of exceptional quality as a result of a cold front that covered the eastern Mediterranean and produced very clear air for razor sharp photographic imagery. Det 4's commander, Col Jay Murphy, was especially proud of his crew's very notable mission accomplishments, but the bad news was that they had flown a degraded aircraft within range of a known Soviet SA-5 SAM site. Overweighing that concern, however, was word from Washington that the take was 'most valuable' for the analysts back at the National Photographic Interpretation Center.

Majors Stormy Boudreaux and Ted Ross deployed '975 to Det 4 on 18 July 1984. The aircraft returned to Beale just three months later on 16 October. (Paul Crickmore)

LIBYA

A group of revolutionary army officers seized power on 1 September 1969 while King Idris of Libya was on holiday in Turkey. In a revolt led by a subaltern named Muammar Gaddafi, the officers proclaimed Libya to be a republic in the name of 'freedom, socialism and unity'. Washington recognized the new regime just five days later, allowing Gaddafi to consolidate his position of power over the next 2½ years, during which time he nationalized foreign banking and petroleum interests within Libya and was called a 'strongman' by western news editors.

Gaddafi made his interpretation of 'freedom, socialism and unity' clear to the world on 11 June 1972, when he announced he was giving aid to the Irish

Republican Army (IRA). Such support was extended to similar terrorist organizations within Europe and the Middle East.

In the summer of 1981, Gaddafi decided to lay claim to territorial rights over much of the Gulf of Sidra, on Libya's northern shore. The United States refused to recognize any extension beyond the traditional 3-mile limit, and to back up the 'international waters' claim to the Gulf, USS *Nimitz* (CVN 68), attached to the Sixth Fleet, began an exercise within the disputed area on 18 August.

Interference from Libyan Mirages, Su-22s, MiG-23s and -25s culminated in the shooting down of two Su-22 'Fitter-Js' by F-14 Tomcats from VF-41 'Black Aces'. This resulted in Libyan-American relations plunging to an all-time low as Gaddafi's aggression continued. Northern Chad was annexed by Libyan forces, an English policewoman was shot dead by a Libyan 'diplomat' in London; arms were sent to Nicaraguan Sandinistas and continued support was given to terrorist organizations throughout the world.

US patience was running out. In an address to the American Bar Association on 8 July 1985, President Reagan branded Libya, Iran, North Korea, Cuba and Nicaragua as members of a 'confederation of terrorist states'. Libya's political ruse finally reached its end after further actions in the Gulf of Sidra, the hijacking of a TWA Boeing 727 airliner on a flight from Rome to Athens and the bombing of the La Belle discothèque in Berlin killing three, including two US Army sergeants and wounding 230 – 50 of whom were US military personnel.

THE PLANNING BEGINS

We now join the dots, navigating through the various major stages of planning and executing a major SR-71 mission, at a time when support for the Senior Crown programme within the USAF was beginning to wane, particularly amongst several high-ranking, influential general officers. We begin with Col Frank Stampf.

> The week before Christmas 1985, for those of us assigned to SAC HQ in Omaha, Nebraska, was pretty much the same as many other past holiday seasons. Plenty of parties and social 'get togethers', and lots of opportunities for frustrated aviators now stuck in headquarters staff jobs to swap war stories about the 'good old days'. The pace of work activity had slowed down a bit, although not very much. Those of us at the Strategic Reconnaissance Center (SRC) within HQ SAC were still kept fairly busy

planning, tasking and coordinating real-world reconnaissance sorties being flown by U-2, TR-1, various models of RC-135, and SR-71 aircraft all over the globe on a 24-hour basis. These daily sorties were a critical component of the eyes and ears of the free world as our nation kept close watch not only on our long-time adversary of the Cold War – the Soviet Union – but pretty much all of the Third World hot spots and rogue nations that appeared determined to cause the US and our allies as much trouble as possible during their own quests for power.

Callsign Oil 54, '979 lines up ready for a green light from the control tower to signal it's cleared to take off on a 07:30 departure. (Paul Crickmore)

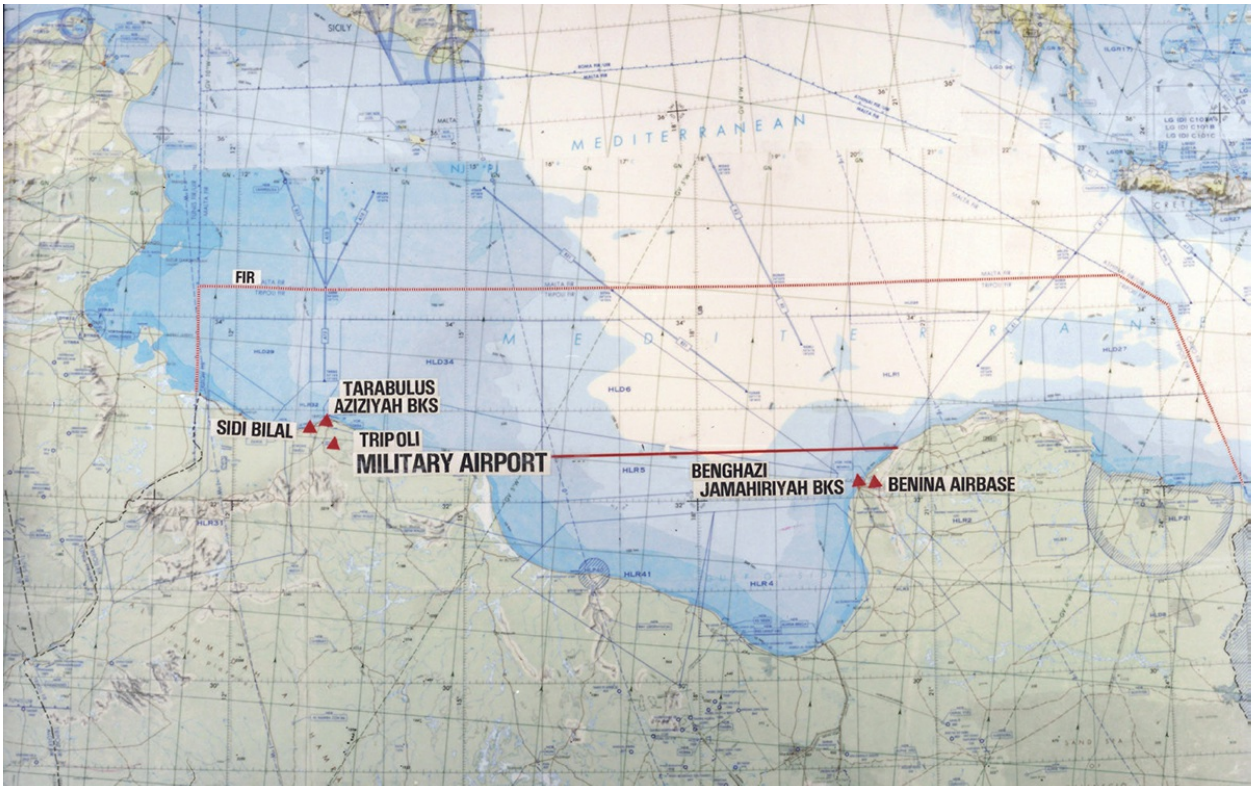
The action officers who staffed the SRC were all experienced former strategic reconnaissance crewmembers – pilots, recon systems officers, electronic warfare officers – relatively fresh out of the cockpit and sent to 'do their time' on headquarters staff jobs. The official Air Force reason for us being at least temporarily 'banished' from operational flying and sent to the headquarters staff was that we needed the opportunity for 'career-broadening' assignments to enhance our potential for eventual promotion. We all knew the real reason was that the senior leadership didn't want us to get the idea that all the Air Force was about was flying airplanes. Silly us …

Meanwhile, our counterparts at the Joint Reconnaissance Center in the Pentagon – also former recce crew dogs – did their best to decipher the myriad requirements they received daily from the military and civilian intelligence agencies demanding SR-71 coverage all over the world. The JRC would then pass those needs to us at SRC. The idea was for us to eventually task the SR-71 wing and operational detachments with specific missions in some reasonably clear terms that would allow the crews (our former squadron mates) to actually fly them.

It was while enjoying the holiday company of a group of friends, their wives and significant others at one of those evening cocktail parties a few days before Christmas that my pager started to buzz. I had to fight off the urge to make believe I hadn't noticed it. I was finally beginning to relax and get into the holiday spirit, and now it appeared I was to be slapped back into reality by a call from 'Mother SAC'. I excused myself and called in to the SRC operations desk to see what was up. I was hoping it was just a routine notification of a sortie delayed or cancelled for weather somewhere very, very far away. No such luck. I was told by the duty officer that I was needed at the headquarters immediately, and that I should bypass the SRC and go directly to the tanker shop downstairs in the bowels of the headquarters building. I made my apologies to the hosts, and very reluctantly left the warm glow of the party for the cold, wet, snowy December streets of Omaha.

Driving toward the base, I was perplexed as to the reason for my recall. Not that I hadn't been called in at all odd hours many times before in the almost three years I had been chief of the SR-71 branch at SRC, it was just that normally the duty officer could give me a hint as to the reason. For example, just the word 'delay' or 'cancel' or 'weather' would be enough to give me the general idea of what was going on (without compromising classified information about specific missions, locations, times, etc.) so I could begin to formulate possible options on my way to the base. Not this time. And being told to report to the tanker operations shop, rather than the SRC, was another surprise. Of course, we worked with the tanker guys all the time – their support was critical to the success of the SR mission. In fact, air-refuelling support for all kinds of fighter, bomber, reconnaissance, and mission support operations worldwide was coordinated and tasked through the tanker shop at SRC. They definitely had the 'big picture' as far as tanker availability and capabilities went.

As I walked into the tanker vault (pretty much all of the operations areas in the HQ SAC building were in secure 'walk-in vaults' where classified information could be openly displayed and readily handled by those authorized), I recognized most of the people standing around as tanker guys, some folks from the airborne command and control division, and a bunch of intelligence types. Almost all were in civilian clothes, as I was, since they had also been called in unexpectedly from what they thought would be a quiet evening with friends or family.



Two target areas were identified to be hit by USAF and US Navy strike aircraft during Operation

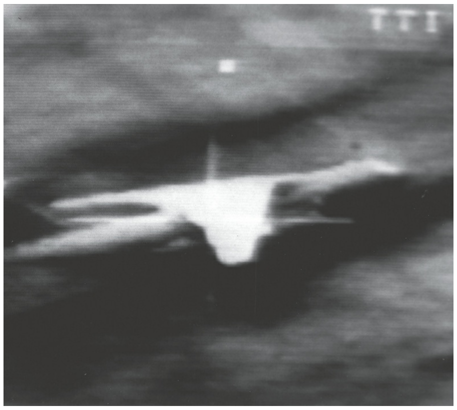
Eldorado Canyon. (USAF)

After a few more minutes, when someone decided that everyone who needed to be there had arrived, we were quieted down and the colonel who ran the tanker ops division stood up. He told us that SAC had just received orders from the Pentagon to develop plans for tanker and reconnaissance support of a bombing raid on Libya. The targets were to be terrorist training compounds and a number of various military facilities such as airfields, air defences, command and control centres, etc.

The raid would take place before dawn and be immediately followed (at first light) by an SR-71 overflight of the target areas to assess bomb damage, which would be critical in determining whether follow-on strikes would be necessary. My first thought was that the timing for the SR-71 overflight would put the crew overhead just when the Libyans were fully alerted … and very pissed off. Apparently, President Reagan finally decided he had just about enough of Muammar Gaddafi. The decision for the US response to Gaddafi was an interesting proposition to begin with, and it would become even more interesting as the mission plans evolved. The operation was to be called *Eldorado Canyon*.

The specific date for the attack was not given, but we were to begin planning our respective roles immediately, and have enough information assembled to provide an initial briefing to the SAC Deputy Commander for Operations and Director of Intelligence – both two-star generals – by 07:00am the next morning, about ten hours from our initial notification. It was going to be the first of many long nights. We obviously wouldn't have the whole operation nailed down in great detail by then, but we were to be prepared to present the various courses of action and recommendations to the SAC General Staff. Then the rest of our resources would be called in and we would begin in earnest to put together the many pieces of what would turn out to be a pretty complex operation. The actual attacks would be carried out by Navy fighter-bombers operating from a carrier in the Med and USAF F-111s flying out of RAF Lakenheath. They would be supported by USAF EF-111s (electronic jamming aircraft), a number of command-and-control aircraft and, of course, about a bazillion tankers.

Obviously, the Navy and USAF fighter-bomber community did the planning for their attack aircraft. The USAF F-111 planners passed on their fuel load and mission timing requirements to SAC, and the SAC tanker crowd figured out how many and what types of tankers would be needed, where they could locate the tracks to safely (both militarily and politically) conduct air refuelling operations, where the tankers would operate from, and how and when to get them where they needed to be. This was never going to be an easy task, although it started out significantly less complex than it ended up.



A Libyan Air Force IL-76 Candid transport aircraft at Tripoli Airport, as seen through an F-111F's Pave

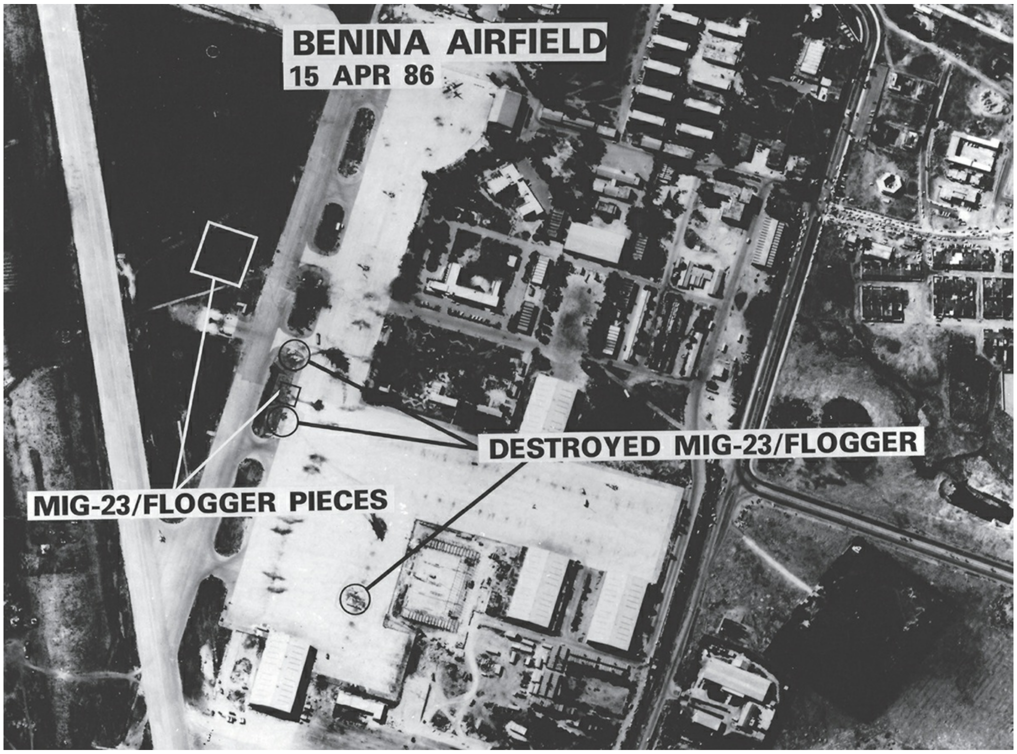
Tack/laser-guided delivery system. The notation at the top right indicates the Time To Impact (TTI) of the 500lbs bomb en route. (USAF)

Eldorado Canyon was the first occasion that KC-10s were used in theatre to refuel an SR-71 whilst participating in an operational mission. (USAF)

The original concept for the Air Force strike component called for eight primary F-111 aircraft actually on target, with another four air spare aircraft launching and flying to a Go-No-Go point where they would be told whether they were needed or not (based upon the status of the primary aircraft). The 'operators' – the folks who knew the aircraft and mission capabilities first-hand and were best qualified to make the call – seemed pretty satisfied that those numbers would do the trick.

However, because the specific date for the attack had not yet been set (or at least it had not yet been shared with us planning the missions), there must have been sufficient time for more and more general officers to get involved in the game. The plan went through several increasingly complex evolutions until the final strike package of USAF F-111s reached 18 aircraft with six air spares. This, of course, exponentially increased the number of tanker aircraft required to get the 'armada' of airplanes from the UK to Libya and hopefully back again.

Just to make matters worse, several weeks into the process the planners were told that the French would not allow any US aircraft, strike or support, to overfly their landmass either on the way to, or returning from, the strike. All of the airplanes would have to fly south, just off the western coast of France, then turn east and thread their way through the straits of Gibraltar to get over the Mediterranean Sea. That translated into several more hours of flying time for all the aircraft, which in turn would require even more tankers than before. Eventually, the plan called for more than 20 KC-135 and KC-10 tanker aircraft to support the USAF strike force, not to mention the SR-71 primary and air spare aircraft. This was not going to be a low-profile operation. In fact, one of the most serious concerns was how to avoid mid-air collisions between the dozens of airplanes that would be traversing the extremely narrow gap of the Straits of Gibraltar in both directions within a short span of time, while radio silent and without being under air traffic control.



One of the few images taken by an SR-71 ever to be released to the media, though its source was never disclosed. (USAF)

THE HABU MISSION

Fortunately for us recce types, that planning problem was one of many logistical and operational challenges that were left to the tanker troops to resolve. All we had to do was put together a plan to get an SR-71 over all the targets on time, with cameras and electronic sensors blazing, defeat what we expected would be very alert and active Libyan defences, and then get the jet back to RAF Mildenhall. There, the mission take would be processed and the intelligence immediately disseminated to all the people who would be anxiously awaiting the strike results. Among those people were numerous military and civilian high rollers, including the chairman of the Joint Chiefs of Staff and the president of the United States, who wanted to be personally assured that the job had been done.

Normally, 'non-routine' SR-71 missions such as this one would be developed by the planners at the operational detachment from which the sortie was to be flown, and the plan would then be passed back to our people at the SR-71 branch of the SRC for review and approval. This made sense, since the folks at the dets were the ones who had first-hand knowledge of the operational environment in which the missions would be flown. However, in this case, there were way too many operational, logistical and political variables that were changing on an almost daily basis (and too many senior officers continuing to get involved) for the Det 4 mission planners to keep up with by themselves. Fortunately, in addition to the very capable and experienced planners at the detachments, we had a couple of pretty solid folks working the task at SRC, including Maj Chuck Holte. Although Chuck was not a former SR-71 crewmember, he had extensive operational experience as an electronic warfare officer, having flown many real-world reconnaissance missions in the RC-135.

He was assigned to the SR-71 branch because of his in-depth knowledge of the ever-changing electronic threat environment, and his expertise was most welcome in not only planning specific SR-71 missions, but in helping us develop strategic plans for future defensive systems that would be needed for the SR-71's continued viability. Chuck's quiet, efficient manner and subtle sense of humour made him highly respected, and, equally importantly, very well liked and trusted by all the SR people who knew him, both at the headquarters and the operational sites. As a result, the Det 4 planners at RAF Mildenhall, from where this mission would be flown, welcomed his input in the planning process for this complex, highly visible tasking.

As the weeks and months went on and the Omaha winter gave way to spring, we still hadn't received a specific date for the attack. However, it seemed that every general in the building wanted daily updates on the plan. The plan, as initially envisioned and quite well laid out, would have been ready to go months earlier, but it seemed as though every general officer to whom it was briefed wanted another change or tweak, so it became the proverbial 'perpetual motion machine'. Consequently, most of us involved in planning the mission had worked every day and some nights, without a break, from the first night we were called out pre-Christmas. That pattern was to continue right up to the day of the attack in April, and for several weeks following, due to the same general officers wanting 'after action' reports and 'lesson learned' briefings.

Chuck's patient nature allowed him to do a remarkable job keeping up with all the changes for the SR-71 mission plan and coordinating them with the Det 4 folks as they came up. Then one day in mid-spring, almost four months after we'd been given the order to develop the plan for the mission, the morning news headlines told of a terrorist bombing at the La Belle discothèque in Berlin. A number of people were killed and injured, among them American soldiers. Almost immediately, links were reported between the terrorist bombers and Libya. We had the feeling that would be the trigger for the president to give the go-ahead for the strike. We were right. The date for the attack was set for 15 April 1986 and the SR-71 plan was ready. At Det 4 – the 'pointy end of the spear' – the Habu crews and all their ops support, maintenance, intel and tanker support people were well prepared and waiting to go.

About 48 hours prior to the scheduled SR launch from Mildenhall, the CINCSAC's executive officer called down to SRC and said the general wanted my boss and me to come up to his office and brief him on the SR element of the mission. I dutifully folded up the mission charts, packed them into our secure briefcase, and the colonel and I weaved our way through the lower vaults of the headquarters building where we went about our classified work every day (and many nights). We eventually came to the stairs that took us up the several flights to where the sunlight and air were and, not surprisingly, the generals' offices.

As a frame of reference for this briefing, it was no secret that SAC did not like having the SR-71 in its operating budget. As I was also responsible for articulating and advocating the SR-71 operating budget within SAC, I was constantly locked in a state of mortal combat within the command to increase, or at times just sustain, funding for the flying hours we needed to meet our growing tasking. The problem was that the majority of that tasking was coming from many sources outside SAC, and even outside the Air Force. For example, the driving reason we established a permanent SR-71 detachment in Europe was to meet the US Navy's critical need to monitor the status of the Soviet Northern Fleet, and in particular its nuclear submarine operations out of Murmansk on the Barents Sea.

Once permanent SR-71 operations were set up and operating in Europe, the US Army realized we could provide excellent coverage of the Eastern Bloc countries around the Federal Republic of Germany, particularly during the darkness and cloud-covered weather of the European winter. The Army was also the primary driver of the regular coverage we provided to monitor hostile force status and movements in and around the Korean peninsula in the Pacific theatre.

SAC was not too happy about having to pick up the tab as the benevolent provider of all that great intelligence to other commands and services, especially when it felt it cut into funding for strategic bombers, intercontinental ballistic missiles and tankers. So, it was no surprise that CINCSAC [Gen Larry Welch] was not a huge supporter of the SR-71 programme (other than, of course, when SAC wanted to make a splash at air shows or other exhibitions, where the SR-71 was always its star performer and biggest crowd pleaser.)

The general had us lay out the chart with the SR-71 track on his desk, and we were to brief him straight from the map. I had gotten about as far as 'Sir, this is …' when he jabbed his finger at the two large rings representing the coverage of the Soviet-made SA-5 SAM sites, both of which were clearly bisected by the SR-71's planned track. One was located at Sirte, near the first target area at Benina airfield in eastern Libya, and the other at Tripoli, to the west. The CINC then asked (while continuing to stare at the very large circles on the map), 'Will these SA-5s be taken out prior to the SR going in?' My response, I thought at the time, was pretty obvious, even for a lowly major like me … 'Sir, we'll know if the sites were destroyed when the SR returns and the intel folks analyse the take.' Wrong answer. The remainder of the 'briefing' went something like this:

SR-71 '980, callsign Tromp 30, was the designated primary aircraft for the 15 April mission and is pictured taxiing back to its barn. (Chris Pocock)

The General: 'I don't want the airplane penetrating those SAMs unless we know they've been neutralized prior to the pass.'

The Lowly Major: 'Sir, there is no way for the SR to collect all of the tasked targets without going through the SA-5 coverage. The SR will be at better than Mach 3 and at or above 80,000ft. The best intel we have on the SA-5 and the SR's ability to defeat it with the airplane's combination of on-board systems and speed and altitude puts this at an acceptable risk level for the mission.'

The General: 'Like I said, Major, I don't want the SR to penetrate those rings unless we know the sites have been taken out.'

The Lowly Major: 'Sir, if we could just …'

The General (this time in a clearly angered tone): *'Major – you are not listening – I'm not going to risk one of MY SR-71s for this piddly little operation!!'*

The Lowly Major: (in thought only …) 'One of "*his*" SR-71s?' "*Piddly little operation!*"'

End of discussion. End of briefing. Back to the drawing boards and with less than 48 hours to come up with an alternative approach.

Although the SA-5 was the most modern and only existing Soviet SAM system with a postulated capability against the SR-71, none had yet been fired at the Habu, and therefore its capability against a high-altitude, Mach 3+ manoeuvring target was still hypothetical. Additionally, we had more than reasonable confidence in the SR-71's on-board electronic defensive systems, when coupled with the airplane's speed and altitude, to handle the threat. On top of all that, this was the very type of mission for which the SR-71 had been designed and had proven itself so well in successfully accomplishing for over 20 years. In fact, even when the programme was eventually terminated four years later, the SR-71 could boast a record that no other USAF aircraft could claim. That is – after 26 years of operational service and hundreds of missions over and around hostile territory, with dozens of SA-2 SAM firings against it during the Vietnam War alone – not a single Air Force crewmember had ever been killed in an SR-71, and none had ever been lost to enemy action.

Notwithstanding the reality of all that, we were clearly going to have to come up with another approach if we were going to meet the tasking that had been levied on us. (In hindsight, if we *failed* to come up with a workable plan, this would have been a perfect way for SAC to say that the SR was tasked, but couldn't support the mission. Another arrow in its quiver to get rid of the programme.)

After a lot of scurrying and many secure phone calls, we were told by our people in DC that there was a *slight* possibility the status of the SA-5 sites could be assessed (by a highly classified intelligence source) in the short period between the time that the last bomb was dropped and the SR-71 came over the target. So, we came up with another plan that none of us liked very much.

The status of the SAM sites, if known by then, could be transmitted via satellite communications to the KC-10 tanker that would be waiting for the SR-71 over the Mediterranean Sea prior to the SR accelerating into the target area. Once the SR-71 was on the tanker's boom and taking gas, the tanker crew would simply pass the words 'Option Alpha' or 'Option Bravo' to the SR crew via the secure boom interphone. The SR-71 RSO would then select one of two flight paths pre-programmed into the ANS computer.

From the end of the air refuelling track, 'Option A' would direct the airplane along the originally planned flight path directly through the SA-5 rings, assuming that intel confirmed the sites had been destroyed. If the sites were either confirmed as still operational, or the information simply wasn't available, then the RSO would select 'Option B', which would take the SR on a peripheral flight path just skirting the operational range of the SA-5s. This flight path would obviously allow the SR-71 to avoid the potential SA-5 threat, but it would also unfortunately reduce the number of targets its sensors could collect, and therefore degrade the usefulness of the intelligence it would bring back.

We at SRC didn't like this plan for any number of reasons. First of all, no SR-71 crew liked to mess around with the ANS once the aircraft was airborne and operating smoothly. The system was certainly capable of doing what was planned in this case, but it just didn't feel right to the crews. But more importantly, by not allowing the SR to fly the mission as originally planned to acquire all the tasked damage assessment of the targets hit by the strike force, there was a great risk of not knowing what was and what wasn't destroyed. This would very likely result in sending more aircraft in for a second strike. As it was, we lost one F-111 crew in the first attack. Another strike, especially if launched unnecessarily – only because the SR-71 wasn't allowed to confirm the targets had already been hit – would just expose more aircrews to the danger of losing their lives for no reason.

But, as ordered, we passed the revised 'Option A and B' plan to the Det planners, and they prepared to execute it as the SR's launch time approached. Frustration levels were high all around. This was one of those times when the crews on the line, getting ready to fly the mission, no doubt wondered what in the world was going on in the minds of their former crewmates at the headquarters who tasked this crazy sortie.

As somewhat of an anti-climax, the 'Option A and B' plan was scrapped for some reason undisclosed to us pretty much at the last hour. The SR crew wound up flying the mission as originally tasked and obviously survived the SA-5 threat to come back with the take. No surprise to those of us who knew and understood the Habu and its incredible capabilities. It is not unreasonable to speculate that the 'highly classified source' that was supposed to provide the status of the SAM sites prior to the SR going in wasn't up to the task, and the SAC general staff was beginning to feel the pressure, both from the Joint Staff and from the White House to produce the much-needed intelligence.

THE DET COMMANDER

Lt Col Barry MacKean was the Det 4 commander during this period. He and his team were tasked to implement the plan, as he recalls:

Planning for the raids on Libya in April 1986 began weeks before the actual flights. Lt Col Frank Stampf from the Strategic Reconnaissance Center at HQ Strategic Air Command in Omaha, Nebraska initially advised me of the pending operation, codenamed *Eldorado Canyon*. At that point everything was handled as Top Secret because of the implications of overflying foreign territory. There was also a great deal of uncertainty about whether the missions would ever be flown due to the necessary approvals required from several foreign countries, most notably the British government. US Air Force involvement in the plan was to be exclusively executed from England.

The F-111 strike would launch from RAF Lakenheath, the EF-111 Raven electronic support aircraft from RAF Upper Heyford, KC-135 and KC-10 refuelling support from RAF Fairford and RAF Mildenhall, while the SR-71 reconnaissance support would also be fielded from Mildenhall. Given the enormity of the plan, world sensitivities at the time and the lack of British involvement, I had my doubts that Prime Minister Margaret Thatcher would approve air strikes flown from England. But fortunately for the free world, and in spite of mounting opposition from within her own party as well as that of Labour, she ultimately approved the missions.

The SR-71 mission was to provide bomb damage assessment for all the target areas struck in Libya; US Navy fighters were targeted against Benghazi in the eastern part of Libya, while the Air Force was targeted against Tripoli and the surrounding area. An additional burden was placed on all Air Force sorties to fly around France, Spain, Portugal and then through the Straits of Gibraltar, because France refused overflight clearance.

The sensor chosen by the Pentagon for the Blackbird mission was the suite of highly sensitive cameras. This choice was based on its ability to declassify the photo images for release to the world press, whereas products generated from our high-resolution radar system would reveal their capabilities and therefore could not be declassified. This decision would prove costly because, while the radar was day/night all-weather capable, the cameras were definitely restricted to daytime operations and clear weather.

Our mission planning team, led by Maj Bruce Blakely under the supervision of the director of operations, Lt Col Bob Behler, developed a very creative flight profile for the Blackbird that maximized target collection while minimizing exposure to surface-to-air missiles and Libyan fighters. Since we had previously flown missions into the eastern Mediterranean area, the same air-refuelling route was selected to help disguise this mission. It consisted of a high-altitude route that unexpectedly turned back to the west covering the targets in eastern Libya and proceeded at Mach 3+ to the capital, Tripoli, before the air defence systems could respond.

When it appeared that *Eldorado Canyon* 'might' be approved, the build-up of tanker aircraft, both KC-10s and KC-135s, began at RAF Mildenhall. Part of the cover story for this highly visible addition of tankers parked everywhere was that a large European exercise, normally scheduled for this time of year, was taking place. There were even photos and stories in the local newspapers to that effect, which helped minimize any potential leaks. To further add credence to the cover and disguise the real operation, at 5am on the morning of the actual mission (the strike aircraft and tankers launched around 5pm in England), the 48th Tactical Fighter Wing at RAF Lakenheath initiated a typical base 'exercise'. This included a recall of all military personnel to their duty stations, generation of aircraft for alert, including uploading conventional weapons, and general exercise activities. Many of the 'exercise' participants were completely unaware of what was about to happen later that day.

Launch of the strike force and tankers occurred in the late afternoon on Monday 15 April. The day prior (Sunday), I received a call from Lt Col Stampf at SRC directing us to cancel our regularly scheduled sorties and configure both of our jets for the pending Libyan mission. One aircraft was designated as primary, the other scheduled to follow a little more than an hour later as back-up, in case the primary aircraft had to abort for aircraft or sensor problems.

Our maintenance team, led by Mr Mel Rushing, consisted of 45 Lockheed personnel with 15 subcontractors and associates from other companies that supported systems/sensors on the aircraft. I had two blue-suit [Air Force] technical sergeants (Robby Butterfield and Jerry Gresham) that provided me quality assurance of the contractor maintenance. The intelligence branch consisted of about 100 military personnel led by Maj Rod Mitchell. This team provided the targeting data for mission planning, processed the film after the mission, analysed the imagery for weapons' effects, and managed all the electrical and conditioned air requirements for the American systems operating under British standards. Bottom line, the entire team was extremely anxious to participate in Operation *Eldorado Canyon*.

Our scheduled launch time was 5am on Tuesday 16 April, to allow for enough light in the target areas to effectively expose the camera film and reveal the damage. With our aircraft and team in full readiness, I departed my office around 5pm for my on-base quarters located at RAF Lakenheath. My staff car was equipped with UHF/VHF radios that allowed me to monitor our operation, as well as that of the tower at RAF Mildenhall. The most amazing thing was happening on the taxiways and runway – tankers were taxiing and taking off with no communication with the tower or departure control. The entire operation was what we call 'comm out' – all movement and approvals were done with lights from the tower, based on timing. It was truly an amazing sight to behold!

As I approached my quarters, I witnessed the same 'comm out' launch of the F-111s, fully loaded with their conventional stores. My wife Terri, an Air Force nurse stationed at the hospital at RAF Lakenheath, had participated in the early morning exercise/recall that day. When I entered the house she told me how for the first time ever, an exercise was terminated early. The cover story was that the exercise had gone so well the wing staff chose to terminate the remaining events. I gave her a set of binoculars and told her to look at the next F-111 that took off. She too was amazed to see the conventional weapons on the wings. I then told her about *Eldorado Canyon*.

After a few hours of restless sleep I returned to our unit to find everything in perfect shape. We launched the primary aircraft flown by Lt Col Jerry Glasser and Maj Ron Tabor uneventfully 'on the hack', comm out. After our spare aircraft, flown by Maj Brian Shul and Maj Walt Watson, launched successfully, several of us went for breakfast. As we got out of the car, the F-111s were returning one by one back into RAF Lakenheath, but this time, there were no weapons on the wings – definitely an eerie sight watching combat aircraft return. One F-111 was lost with its crew and another had to land in Spain with engine problems.

Remember the earlier comment about cameras requiring good weather? Well, we encountered our nemesis, cloud cover over the target area. The primary aircraft flew perfectly and did everything required, our problem was clouds. Both aircraft came back 'code one', meaning not one maintenance discrepancy. Before we even received word from SRC as to a return engagement, I had the maintenance teams preparing both aircraft for possible flights the next day. Everyone was so mission-oriented, there was no problem making it happen. While we awaited the go-ahead from SRC, our intelligence team was pouring over the film with hopes of getting enough usable imagery to complete a full BDA report. Unfortunately, when it came to the area around Tripoli, there was none to be had.

With SRC approval, we swapped the aircrews and jets and flew the very next day. Our mission planners cleverly altered the flight plan to preclude predictability and to minimize potential threats. However, on this occasion the lead aircraft experienced a malfunction of the optical bar camera. Although the other cameras performed flawlessly, the target areas were obscured by sand storms. Because of the high level of national interest, joining our imagery analysts to review the film was Maj Gen Thomas McInerny, the Third Air Force commander, stationed at RAF Mildenhall. He understood we had no control over Mother Nature and was very supportive of the efforts of our personnel. However, senior leadership was adamant that we provide releasable BDA.

Without missing a beat, our team prepared both aircraft for a third consecutive flight. SRC gave approval and the two jets departed RAF Mildenhall for the third and finally successful time. This time the primary crew was Lt Col Bernie Smith and Lt Col Denny Whalen, with the spare crew being Lt Col Jerry Glasser and Maj Ron Tabor. As fate would have it, the target area was clear and we were able to provide good BDA as tasked. However, this was all very frustrating to us in the 'recce' team because we knew that we could have provided BDA imagery after the very first sortie had we been allowed to use our very sophisticated radar system.

Besides finally providing the much-sought-after BDA, our team established a benchmark for SR-71 sorties generated and flown that was and remains unparalleled. We flew six sorties in three days with only two aircraft, supported by a maintenance team that was staffed to support only two to three sorties a week. As the commander of the unit, I was extremely proud of their accomplishments and the manner in which everyone pulled together. Definitely in keeping with the Habu tradition!

RSO Ron Tabor (left) and Jerry Glasser, congratulate one another at the foot of the gantry after having successfully completed the first Bomb Damage Assessment (BDA) mission after the 15 April 1986 raid. These three images are of poor quality, but included as they're a unique record. (USAF)

Det Commander Lt Col Barry MacKean (left) and Ron Tabor have a few brief words about the mission in the hanger prior to attending the full debriefing. (USAF)

Director of Operations (DO) Col Bob Behler begins the debriefing process with Jerry and Ron. (USAF)

MISSION EXECUTION

Lt Col Jerry Glasser, an SR-71 instructor pilot and director of simulator training, with over 900 hours of Habu flight time already under his belt, together with his RSO Maj Ron Tabor, an RSO instructor and the chief back-seat simulator instructor, were the primary aircraft crew for BDA after the attack. Majors Brian Shul and his RSO Walt Watson were nominated to fly backup first time around. A third crew, Lt Col Bernie Smith, the Chief of Stan-Board, and instructor RSO Lt Col Dennie Whalen were en route to join their colleagues via KC-135; they would fly a later mission over Libya. Jerry provides a unique insight into that first sortie:

> As the tasking came down and the F-111s geared up, we were directed to equip the aircraft with optical sensors, an OBC in the nose and TEOCs in the chine bays. The weather could always be a problem with visual sensors, but they provided the best image quality and this was very important for Washington.

The plan was to launch the two aircraft with a time interval between them that would ensure that if all went according to plan, primary would just be coming off the target as the back-up air spare was just about to turn into the Mediterranean refuelling track. If primary had sustained some kind of mechanical or sensor malfunction, back-up would continue into the area and get the take. If, however, primary cleared the target area and reported 'ops normal', back-up would turn back to England prior to the Straits of Gibraltar. Three air refuelling tracks were planned to support the mission, one off Land's End, England and two in the Mediterranean.

An area of concern for us as crewmembers was the decision that the second air refuelling in the Med was to be conducted from a KC-10 at 31,000ft. This was 6,000ft above our usual refuelling block altitude. Checking the Mach/IAS limits for the KC-10 confirmed that we'd be 'well behind the subsonic power curve while behind the boom.' From what I recall, even the KC-10/SR-71 compatibility checks carried out at Palmdale didn't get up to 31,000ft. A second and common problem, as we learned later at first-hand, was the 'brutal sun angle', which would be directly down the boom.

Mission brief was at 3:00am. Brian and Walt were also our mobile crew, so after seeing us off, they had to get suited and launch as airborne back-up. Our route was subsonic to Land's End, where we'd be topped off by two KC-135s. We'd then climb and accelerate south along the Portuguese coast, then make a left turn through the Straits of Gibraltar, decel and refuel in the western Med. Our second accel was on an easterly heading and we'd then make a right, climbing turn to the south and head directly for our first target – Benghazi. We'd then perform a hard right to slip by the SA-5 sites at Sirte and then fly on to Tripoli, our second target. The plan then called for a post target decel for our third and final AR in the western Med before our final accel exiting again through the Straits, then on to a northerly heading that would take us back to the UK.

'980 is pictured just prior to touchdown on 18 April 1986. It's still equipped with the Optical Bar Camera (OBC) nose section, carried during *Eldorado Canyon*. (Bob Archer)

The main thrust of the strike was to be conducted by 18 F-111Fs from RAF Lakenheath, split into six flights of three aircraft each using call signs Puffy, Lujan, Remit, Elton, Karma and Jewel. More than 20 KC-10s and KC-135s provided air-refuelling support for the strike force. In addition, three EF-111

Ravens provided ECM support.

Hours before the Habu launched, the first of its support tankers got airborne, as four KC-135s and KC-10s left the base for their refueling orbits:

- Finey 50 and Finey 51 launched at 02:30am and 02:40am (KC-135 59-1520 and KC-10 83-0079)
- Finey 52 and Finey 53 launched at 04:02am and 04:05am (KC-135 58-0125 and KC-10 83-0082)
- Finey 54 and Finey 55 launched at 04:12am and 04:15am (KC-135s 60-0342 and 58-0094)
- Finey 56 launched at 07:40am (KC-10 83-0075)

Lt Col Jerry Glasser and Maj Ron Tabor took off as scheduled at 05:00am in SR-71 '980 (call sign Tromp 30), and Jerry continues:

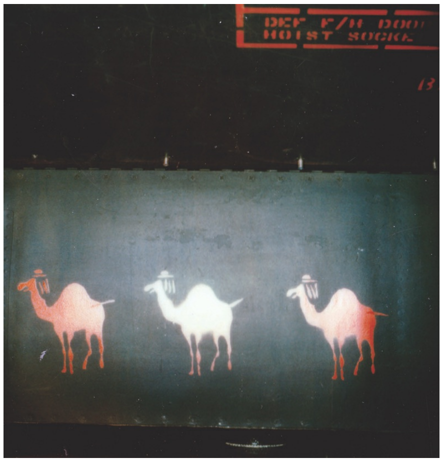
> For take-off we carried 55,000lb of fuel, which was 10,000lb more than normal. A night launch down Mildenhall's 8,500ft runway was always exciting. From a safety aspect, I always had concerns for the buildings at the end of runway 29, especially when we were heavy.
>
> We rendezvoused as planned with Finey 54 and Finey 55, which had entered a holding pattern off the southwest coast of England. Our first AR was fine except for a little turbulence; we then made our first accel towards the Med. The early morning accel with the sunrise and the coast of Europe to the left painted a wonderful scene and the turn through the Straits of Gibraltar was quite spectacular – we were prohibited from taking random photos of the Straits.
>
> Our second AR had a KC-135Q acting as lead to a KC-10 in trail; this was due to the special comm/ranging equipment carried by our tankers. We thought it was overkill, but it worked out fine. The '135 flew one mile ahead of the KC-10 and we ranged on both. The weather was clear, but the sun angle was a big problem. This refuelling, scheduled for 31,500ft, was the highest ever attempted in the SR-71. Apparently the planners wanted to stay above the major airways and have a 500ft separation with IFR traffic. We didn't know of this until the morning of the mission and were a bit surprised!
>
> As we hooked up at 31,000ft I couldn't see the tanker's director lights due to the glare. The KC-10 was airspeed and Mach limited at that altitude and couldn't accelerate to 350KIAS after the hook-up. We were well behind the power curve, flying slower than 300KIAS, but I'd talked to the KC-10 boomer prior to the mission and this proved to be an invaluable conversation – as a result, he fully understood the speed/altitude incompatibility issue and that the sun angle was likely to cause a problem. I had two boom disconnects before I settled down, and to further help reduce the glare, Ron got the tanker to turn 10° right and I 'hid' under its number one engine nacelle.
>
> To stay on the boom we had to go to afterburner at 55,000lb compared to 76– 77,000lb, where we'd normally engage the left 'burner (depending on the outside air temperature) to get a full fuel load from a KC-135 at our usual altitude. Ron, my RSO, did a masterful job managing the on-load; he knew I was just hanging on for the last 27,000lb. Knowing that the director lights were of no help to me, the KC-10 boomer also did a fine job keeping us plugged in. We had the right engine at Mil power and were modulating the left afterburner to stay on the boom. The boomer had not seen that

> before and was getting concerned over the bank angle for the disconnect, but it worked out. I have to say, I completed many air refuellings in the SR, in good and bad weather, pitch black night, even in an area we called the 'black hole' off Kadena over the Pacific, at night, with no moon and rough weather, but that second AR was my most challenging.
>
> As we began the second accel the right A/B wouldn't light, but a little manual rise in exhaust temperature, together with another shot of TEB, and we were off again. We entered a solid cirrus deck at 41,000ft and I began to get a little concerned, since we didn't break out until we reached 60,000ft. However, as soon as we were clear, there dead ahead of us was the coast of Africa and Ron got set for the Benghazi take. As we levelled off at 75,000ft and our cruising speed of Mach 3.15, the bird was running just beautifully. I knew to leave Ron alone during this phase, as he was really busy. The DEF warning lights started to flash and Ron signalled that all was a GO. The take seemed normal as we made our hard right turn towards Tripoli and we were tuned for the SA-5 site at Sirte. Again warning lights flashed, but nothing was visible – we truly felt invincible at Mach 3.15.
>
> The weather over Tripoli wasn't good. As we completed the run and turned out of the area, Ron gave an 'ops normal' call, so Brian and Walt, who were fast approaching the pre-designated abort point, made a right turn short of Gibraltar and headed back to Mildenhall. As it subsequently turned out, morning fog cut out some of the optical take around Tripoli and two more missions would be required to complete the BDA picture – one due to weather, the other to sensor failure (the OBC).
>
> Our third and final refuelling, conducted down at 26,000ft, was uneventful; we pressure disconnected off the boom and headed home, once again through the Straits. The remainder of the mission was 'normal, normal, normal', as Ron and I made our final descent into the UK and called 'London Mil'. I still plainly recall the impeccable English that gave us both a little lift, 'Good morning, gentlemen, it's been a long day for you.' It's with some nostalgia and a great sense of pride that I enjoyed such a professional association with British controllers. As we were handed over to the various controlling agencies on our way back to Mildenhall, we were eventually vectored to runway 11 for a GCA approach.
>
> The landing was uneventful and as we taxiied back to the 'barn', there were Brian, Walt, Bernie and Dennie in the mobile car to greet us. But, as was my habit, as I stepped from the gantry ladder the people I first made sure to shake hands with were the maintenance chiefs, who, through their professionalism, had enabled Ron and me to fulfil our part of the mission.

As planned, Maj Brian Shul and Maj Walt Watson had launched at 06:15am in aircraft '960 (call sign Tromp 31) and duplicated the route flown by Glasser and Tabor to the first ARCP with Finey 54 and 55 off Cornwall. Shul spotted the returning F-111s approaching head-on several thousand feet below. Lujac 21's pilot (the F-111 flight leader) rocked his wings in recognition and Shul returned the time-honoured aviation salute with a similar manoeuvre.

The final tanker (KC-10 83-0075) joined *Eldorado Canyon* to support the return of the two Habus.

At 09:10am a KC-135Q (call sign Java 90) landed at Mildenhall carrying senior members of the 9th SRW staff from Beale to witness the mission debriefing. Twenty minutes later, tankers Finey 54 and 55 touched down, followed at 09:35am by Tromp 30, which had flown a mission lasting 4½ hours. One hour and 13 minutes later, Shul and Watson landed the Habu back up. The five remaining tankers returned over the next 4½ hours. Finey 51 flew a 12½-hour sortie. When Finey 56 landed at 03:26pm, *Eldorado Canyon* was completed, with the exception of search efforts for Captains Ribas-Dominicci and Lorance, whose F-111 had been lost the previous night off the coast of Libya.



Three mission marks in the form of dark red camels were painted on the left nose gear door of '980. The routes flown by the SR-71 during these missions over Libya were designated GC-107 – 'GC' standing for 'Giant Camel'. (USAF)

SR-71 '960 inadvertently put on a particularly impressive display for the crowds attending the 1986 Mildenhall Air Fete. (Bob Archer)

The mission's take was processed in the Mobile Processing Center and it was then transported by a KC-135 (Trout 99) to Andrews AFB, Maryland (only 25 miles from the Pentagon and White House), where national-level officials were eagerly awaiting post-strike briefings. The world's news media had been quick to show the bad side of the story, with BBC reporter Kate Adie used as a propaganda dupe to show not only where one F-111's bomb load went astray near the French embassy, but also where Libyan SAMs had fallen back on the city but were claimed to be US bombs. But she also provided useful post-strike reconnaissance by showing the accurately bombed terrorist camp, referred to by her as a 'cadet school'.

The marginal weather around the Libyan capital forced another Habu sortie to be flown the following day. This time Jerry and Ron were back up in aircraft '980 for Brian and Walt, who were the primary crew in aircraft '960; Bernie and Dennie were the mobile crew, charged with overseeing the launches and recoveries back into Mildenhall. During the sortie the primary aircraft suffered a sensor failure and for unknown reasons the back-up aircraft, which was in the air and operational, wasn't contacted. This required a third mission, completed on

17 April by Bernie and Dennie as the primary crew in aircraft ’980, backed up by Brian and Walt in ’960. To preserve security, the mission call signs were changed, Fatty and Lute being allocated to the tankers and SR-71s, respectively, for the 16 April mission, and Minor and Phony used the next day.

Some commentators have claimed that the Libyans fired SAMs at the SR-71s during these missions. This has been confirmed as definitively not the case by Lt Col Ron Tabor, who in addition to flying the first mission, was also a senior RSO and instructor. In addition, Lt Col Frank Stampf said, ‘We at SAC HQ, along with several other “special” agencies monitoring the progress of the mission in real time and looking for enemy reactions, saw no evidence of an actual launch after the fact.’

Photos taken in the vicinity of Benghazi by Tromp 30 on 15 April were released to the press, although the source was never officially admitted and image quality was purposely degraded to hide the system’s true capabilities.

Bellicose rumblings from Gaddafi continued after the raid, and 14 months later, the west’s intelligence services believed that Libya had received a number of MiG-29 ‘Fulcrums’. This outstanding fighter would considerably enhance Libya’s air defence network. It was therefore decided that Det 4 should fly another series of sorties over the Libyan region to try and confirm these intelligence reports.

On 27, 28 and 30 August, both SR-71s were launched from Mildenhall to photograph all the Libyan bases. Tanker support for each operation consisted of three KC-135s and two KC-10s. The tankers and the Habus used the call signs Mug, Sokey and Baffy. Two other KC-135s (Gammit 99 and Myer 99) flew courier missions to Andrews AFB, Maryland on 29 August and 9 September to transport the take to the Pentagon, where intelligence analysts failed to find the MiGs they had suspected.

Thereafter, until 22 December 1988, it appeared as though the Libyan leader and his regime might have learned a lesson about US intolerance of international terrorism. However, on that night, high over the small Scottish town of Lockerbie, Pan American Boeing 747 Flight 102 was blown from the sky by a Libyan bomb. In all, 259 passengers and crew and at least 11 people on the ground were killed, making this Britain’s worst air disaster.

THE BIG MiGS

The emergence of the Convair B-58 Hustler, the Lockheed A-12 and SR-71, and potentially the North American B-70 Valkyrie and Lockheed B-12 inevitably provoked the Soviet Union into developing weapons systems capable of defeating these potential high-speed, high-altitude intruders. As early as 1960, the Mikoyan-Gurevich Opytno-Konstruktorskoye Byuro (OKB; design bureau) was tasked with developing a new, high-performance interceptor to take them on.

The result was the first 'big MiG' – the seemingly spectacular MiG-25. Officially entering service following a directive dated 13 April 1972, the first *Protivovozdushnaya Oborona Strany* (PVO; Anti-Air Defence Troops) MiG-25P units were stationed near Moscow, Kiev, Perm, Baku, Rostov and in the north and far east. By the mid-1970s, the MiG-25P constituted the backbone of the Soviet Air Force's interceptor inventory, and soon after converting to type, PVO units stationed near Soviet border areas were carrying out intercepts on SR-71s involved in peripheral reconnaissance missions of the Soviet Union.

On 6 September 1976, Lt Victor Belenko, the pilot of a PVO unit based at Chuguyevka, located to the north of Vladivostok, defected to the West via Japan in 'his' MiG-25P, providing the US intelligence community with a windfall. The aircraft was dismantled by US Air Force intelligence staff, and although later returned to its country of origin, it was obvious to Soviet officials that the aircraft's capabilities were now severely compromised and unless the design was drastically upgraded, the type's combat efficiency would be enormously degraded.

In a joint effort that involved the Ministry of Aircraft Industry and military experts, the Mikoyan-Gurevich OKB embarked upon a comprehensive upgrade programme. The earlier monopulse low-pulse repetition frequency Smerch-A2 (Izdelye 720M) radar was replaced by the much-improved Sapfeer-25. This new radar unit was larger than its predecessor and required a modest fuselage stretch forward of the cockpit; its improved capabilities enabled detection of targets with an RCS of 16m^2 at a range of more than 100km (62.5 miles).

An infrared search and track (IRST) system was developed which, when coupled with the radar, made the weapons system less susceptible to the effects of ECM; it also provided the platform with the ability to perform 'sneak attacks' without switching on the radar. The upgrade also included installation of the BAN-75 target indication and guidance system that acted in concert with the ground-based Luch-1 guidance system to align the optical axis of the aircraft's radar with the target; this also ensured that its radar was less sensitive to jamming. In addition, a new IFF set and ground-based command system were provided (the latter replaced the Vozdookh-1M and incorporated a jam-proof aircraft receiver).

Four R-60 missiles would be carried instead of four R-40TDs, which, due to more effective homing heads, almost doubled the range of the earlier weapons. Finally, and perhaps not surprisingly, the upgraded platform would be powered by newer engines, two R-15BD-300s. Work progressed rapidly on the design, designated MiG-25PD or Izdelye 84D (D for Dorabotannyy, meaning modified or upgraded), and by the end of 1982 the entire fleet had also undergone a mid-life update programme, leading to the designation MiG-25PDS (Perekhvatchik, Doralotannyy v Stroyou; field-modified interceptor).

There now follows an insight into MiG-25PD operations as conducted by the 787th Istrebitelniy Aviatisonniy Polk (IAP; fighter aviation regiment) against Det 4 SR-71s flying over the Baltic Sea. It is reproduced by courtesy of Lutz Freund, editor of *Sowjetische Fliegerkrafte Deutschland* 1945–1994.

Around 1980, the Warsaw Pact's air defence forces (PVO) introduced a new alarm call – 'Jastreb' (hawk). It meant that a Lockheed SR-71 Blackbird was approaching. Later on, it became the standard alarm signal for all high and very fast-flying targets.

Under normal circumstances the alarm call came several minutes before an SR-71, typically flying at an altitude of 20 to 25km at some 800–900m/s, entered the range of Soviet and German Democratic Republic (GDR) air surveillance and guidance radars. At Finow air base the alarm resulted in the 787th IAP scrambling a MiG-25PD fighter. They took off and approached the intruder in a wide curve on a parallel course, with a separation of a few kilometres. During this MiG-25 manoeuvre the aircraft overflew all of the GDR's northern or southern area. On military maps the MiG-25's flightpath was shown as a large circle.

Depending on the weather, SR-71s flew reconnaissance missions once or twice a week along the Warsaw Pact border. During military manoeuvres flight frequency could rise to two missions every 24 hours. The aircraft used two standard routes. The approach towards GDR airspace was from Denmark. Over the West German city of Kiel the flight path continued either to Aufklärungsstrecke 2 (reconnaissance route 2), along the Baltic Sea coast line to Leningrad (now St Petersburg) and back, or to Aufklärungsstrecke 5, along the GDR's western border. Such missions normally lasted around 60 minutes. The distance to the border varied due to the aircraft's high velocity and it was unable to follow the border's exact line. Sometimes an SR-71 came within a few kilometres of GDR's border in the area of Boizenburg, or just slipped over it.

Had there ever been an order to shoot down the intruder, the MiG-25 crews were ready. But the routine of this event never escalated to such a dramatic situation. After a short time flying alongside the SR-71, the MiG-25PD headed home. The usual flight past home to Finow was over Poland.

The first big MiG was the MiG-25. However, the design was compromised when Lt Victor Belenko defected with one to Japan on 6 September 1976. This resulted in a complete redesign and the MiG-25PD (Yefim Gordon)

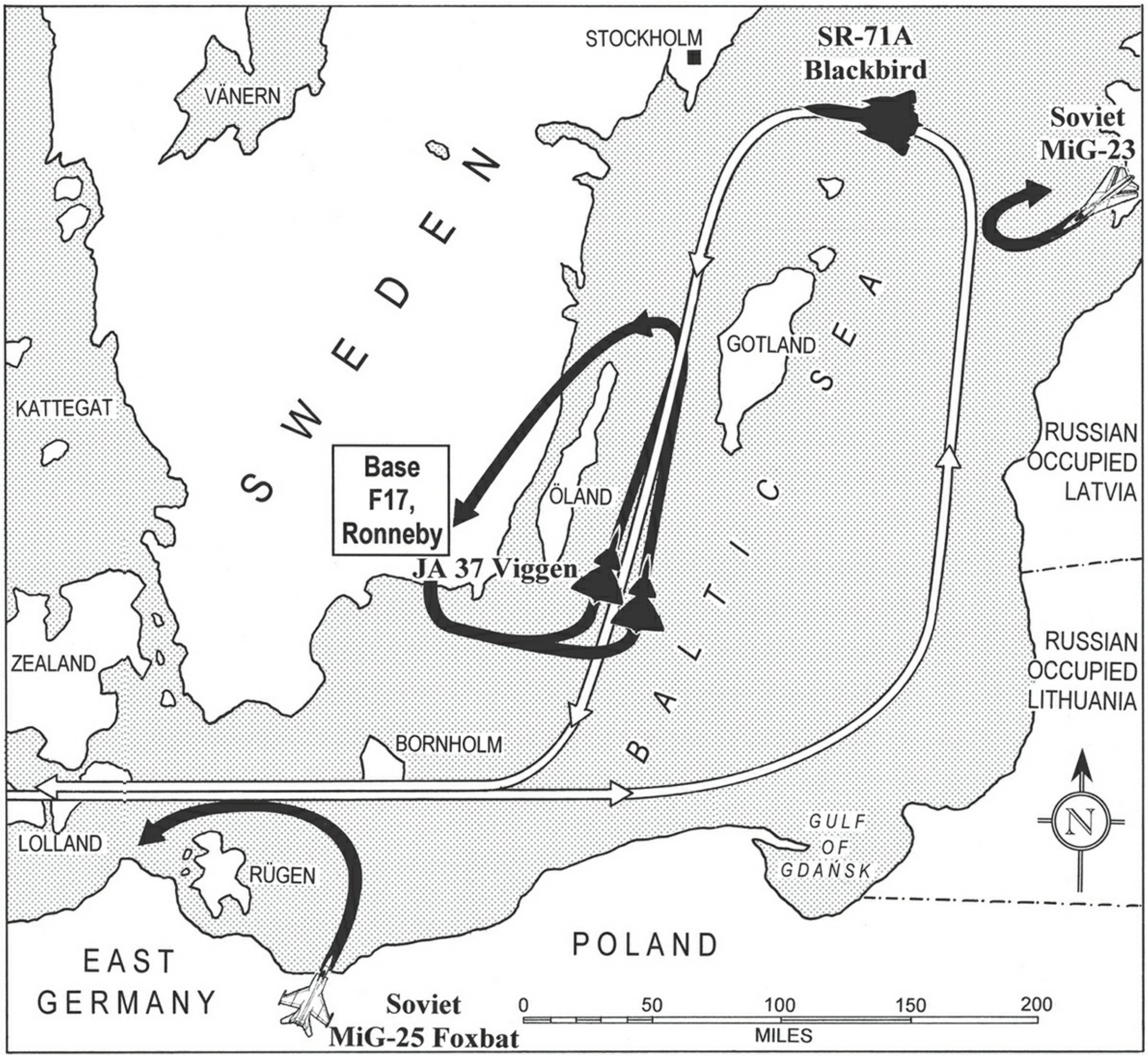
Beside the airborne defenders, the missile defence forces were also on alert. It would have been possible to successfully destroy the intruder, but for a successful lock-on and shootdown they would need a slightly lateral shot to reduce the extreme altitude. The missile defence forces remained on alert as long as the SR-71 was detected in the region by Soviet radio-listening troops.

Finow-Eberswalde was built in 1936 and used by Soviet forces from 1945. With the introduction of MiG-25PU its runway (10/28) was lengthened to 2,510m. Between 14 July 1982 and 10 August 1989, the 787th IAP operated MiG-25PD from the base, more or less coincident with the period of SR-71 operations out of Mildenhall, UK. After the withdrawal of the SR-71 from the UK, MiG-23s and MiG-29s replaced the MiG-25.

HABUS, VIGGENS AND FOXBATS

The SR-71's awesome performance capabilities also provided a unique opportunity for allied fighter controllers and fighter pilots to evaluate various intercept solutions against a high-speed, high-altitude threat, as Rolf Jonsson, a retired Swedish Air Force fighter controller, now recalls:

> The most spectacular alerts in the Swedish Air Force during the eighties occurred about once a week, when the Blackbird was operating in the Baltic. These were also probably the most frustrating events of the entire Cold War, with our fighters trying to reach the same altitude and position as this high-speed, high-altitude target, efforts which, if successful, would allow the fortunate pilot to catch a brief glimpse of the fantastic SR-71 at quite close quarters.
>
> When the SR-71 first began operating in Europe our air force was equipped with the Saab J 35F Draken and although intercept attempts were made, the aircraft's performance wasn't up to the task. However, one point was clear – the method that offered the greatest opportunity of success was a frontal attack, with both aircraft exactly on a 180° divergent heading – always assuming of course that the SR-71 didn't turn! Other very important factors to try to determine when planning an intercept were the high-altitude air temperature and the SR-71's altitude.


SR-71A
Blackbird
STOCKHOLM
VÄNERN
Soviet
MiG-23
SWEDEN
GOTLAND
KATTEGAT
BALTIC SEA
RUSSIAN
OCCUPIED
LATVIA
Base
F17,
Ronneby
ÖLAND
JA 37 Viggen
RUSSIAN
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LITHUANIA
ZEALAND
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LOLLAND
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MiG-25 Foxbat
0
50
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MILES

This map shows the SR-71's standard route around the Baltic Sea, with the typical 'engagement' zones of the Soviet Air Force MiG-25s, MiG-23s and Swedish Air Force JA 37 Viggens against it. (Osprey)

Swedish Air Force Fighter Controllers reported that efforts by MiG-23ML ‘Floggers’ based at Pamu-Haapsalu and Tapa, Estonia, to conduct intercepts against the SR-71 were ‘pathetic’. (Yefim Gordon)

When the Saab JA 37 Viggen entered service, suddenly the mix was right; the aircraft’s performance and avionics capabilities combined with the eagerness of its pilots and a high degree of teamwork with the air command and control centres, including the radar tracker (a conscript), the intercept controller and the pilots.

For everything to work, the pilot needed to reach the speed and altitude that corresponded with information derived from the data tracker system in the Air Operations Centre (AOC). This data determined exactly where and when the pilot needed to initiate a pull-up from cruising altitude to acquire a radar contact. If the pilot failed to lock his radar on first time that was it, the opportunity was gone – at least for another week. On some occasions our pilots had problems locking on because the SR-71 crew activated their defensive countermeasure systems, but pilots soon learned how to avoid triggering such systems. Also, an electronic counter-countermeasures system was built into the JA 37.

Another high-performance aircraft operating from bases around the Baltic was the Mikoyan-Gurevich MiG-25 ‘Foxbat’; this had a speed advantage on the JA 37 Viggen, but the latter had a superior weapon system and, from 1981, was already using an information dissemination system similar to the Joint Tactical Information Distribution System the US later deployed on tactical aircraft including the F-15C Eagle.

The most difficult phase of the intercept for pilots was during the steep climb, since they had to monitor their engine instruments to ensure they remained within the Volvo Flygmotor RM8B turbofan’s EGT limits, and also scan their radar screens. During this phase the pilot tilted his radar scan angle down, to its maximum of -15°. The radar then had just a few seconds to locate and then lock on to the target before the two aircraft passed one another with a combined closing speed of Mach 5; it was an extremely impressive spectacle to watch on radar from the ground!

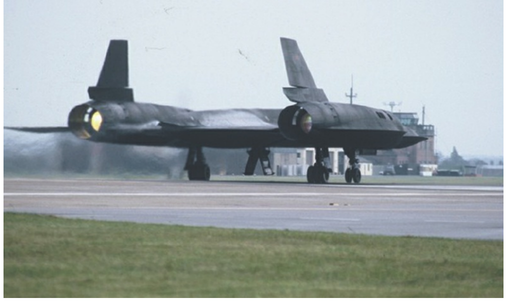
The intercept window was incredibly tight, and all the SR-71 pilot needed to do during the fighter’s final climb phase was manoeuvre just slightly and the intercept solution changed and failed. One of the main problems facing our Viggen pilots was that one of the rules in their Orders for Safe Flight stipulated that flight above 52,500ft was prohibited without the use of a full pressure suit and

> these weren't available, so our pilots needed to be careful or they could be grounded by their divisional commanders.
>
> The SR-71 'Baltic Express' flights were usually known about an hour before the aircraft entered the area. The Habu always entered the Baltic Sea over a reporting point named 'Codan', located about 80km south of Copenhagen and on a heading of about 090°. This usually triggered a scramble by a pair of JA 37s that were kept on alert at either F10 Ängelholm, F17 Ronneby or F13 Norrköping, although sometimes even temporary bases like Visby were used. The best base for an SR-71A intercept, however, was F17 Ronneby, because this was best positioned for the acceleration and climb phase, about 30–50km southwest of Gotland and Öland.
>
> The SR-71's Baltic flight path remained the same throughout the time it operated in Europe and consisted of a single anticlockwise loop that took about 30 minutes to complete [interviews with Habu crewmembers that flew 'Baltic Express' missions from 1984 have stated that there were occasions when two loops were flown within the Baltic]. It remained in international airspace and first flew off the Polish coast, then just before the Bay of Gdánsk, well inside the Kaliningrad enclave, the aircraft turned left, onto a heading of about 015°. With the Habu now flying at 70– 80,000ft only the Sukhoi Su-15 'Flagons' based at Vainode, in Latvia, had a chance of making an intercept, and it's doubtful that any of them were actually successful. Certainly the MiG-21 'Fishbeds' and MiG-23 'Floggers' based at Pamu, Haapsalu and Tapa in Estonia had no chance; their trails on our radar screens in Sweden were so harmless it was painful!
>
> The Habu then proceeded to a point about 60km west of the Estonian island of Saaremaa, where it began a long, programmed left turn, taking it onto a southerly heading of about 190°, rolling out east of Stockholm. It then passed between the islands of Gotland and Öland, and this always impressed us because the corridor of international airspace between the two islands is only two miles wide; the Habu only violated our airspace once (this was the only time that it became necessary for the Swedish foreign department to protest about an airspace violation) when an SR-71 was forced to interrupt its high speed left turn, reduce speed and descend from its position in the north of its route due to an inflight emergency. [On that occasion, the SR-71 was forced to fly directly over Gotland – at this point AJ 37 Viggen pilots took hand-held photos of the Habu and it is clear to see from these that the aircraft was flying on one engine]. It was in this area that our JA 37 pilots carried out their practice intercepts. Once 56–74 km southeast of Gotland and Öland, the 'Baltic Express' turned onto a heading of about 265° and exited the area over the same point that it had entered.
>
> Almost every time the SR-71 was about to leave the Baltic, a lone MiG-25PD 'Foxbat-E' belonging to the 787th IAP at Finow-Eberswalde in the German Democratic Republic was scrambled. The 787th maintained three squadrons (around 40 aircraft), which may have flown only the MiG-25PD, but probably consisted of two MiG-23M 'Flogger-B' units and one of MiG-25PDs. A detachment of the latter was also maintained at Wittstock. Another detachment might have been based in another southern airfield in East Germany. Arriving at its exit point, the 'Baltic Express' was flying at about 72,000ft and the lone MiG would reach about 63,000ft in a left turn before rolling out and always completing its stern attack 1.6nm behind its target. We were always impressed by this precision; it was always 63,000ft and 1.6nm behind the SR-71.
>
> When the SR-71 detachment at Mildenhall was deactivated, the 787th IAP re-equipped with new Mikoyan MiG-29 'Fulcrum-Cs', but even after the withdrawal, we believe that at least three 'Foxbats' remained behind at Finow-Eberswalde, just in case the 'Baltic Express' returned!

It is interesting to note, when reading Rolf Jonsson's account involving a lone MiG-25PD out of Finow-Eberswalde, that the simulated attack consistently terminated when the interceptor was at 63,000ft and 1.6nm behind its target; this would seem to suggest that these were the parameters necessary for its weapons system to effect a successful intercept if the order to fire was ever given. This is interesting, since US Air Force intelligence specialists (and SR-71 crewmembers) believed that the only possibility of an interceptor successfully engaging an SR-71 would be head-on (or beak-to-beak), a position given further credence by the fact that the DEF system designed to tackle an airborne threat operating within the X-band (DEF A2) was forward-facing.

Major Tom Danielson and his RSO Lt Col Stan Gudmundson get airborne in '973, callsign Yale 16, in November 1986. (Paul Crickmore)

Det 4 Commander Lt Col Nev Cunningham (left) and Joe Kinego, 1st SRS Commander, catch up on the latest developments at the UK detachment. Both had extensive experience flying the SR-71 within European airspace. (Paul Crickmore)



As both throttles were pushed into full afterburner, the engines tended to light asymmetrically. Note the left engine delivering full power but the green flash in the right engine indicates that TEB had only just ignited the burner cans in the afterburner. The power differential was compensated for by nose-wheel steering (as seen by the rudder deflection). (Paul Crickmore)

The key to the JA 37's success was the integration of a highly sophisticated datalink, which, until relatively recently, remained highly classified. The Swedish air force gained significant expertise in the datalink field with a system installed in the JA 35F back in 1965. However, the system installed in the JA 37 Jaktviggen (or fighter Viggen) was far more capable than that of its predecessor; it entered service in 1982.

It had the ability to upload and download data to four active aircraft on the same link; it also had the capability of downlinking data from an airborne JA 37 to others still on the ground. Datalink information was displayed on the horizontal situation display (HSD) and a tactical display, the latter using link symbology that could be overlaid with an electronic map on a multifunction display (MFD). As an integral part of the Stri-60 command-and-control system that was built around it, the JA 37 could take off, attack, land, refuel and rearm, then re-engage, with little or no voice communication, while enduring heavy jamming.

The first successful intercept of an SR-71 over the Baltic was carried out by Per-Olof Eldh, who recalls the incident:

> When I conducted the first Swedish Air Force intercept of an SR-71, the target had completed its northbound pass off the Soviet coastline, and had turned west, south of the Finnish island of Aland, and was tracking south on a heading that would take it between Gotland and Öland. The datalink from the fighter controller was on, and I lined up for a head-on attack with a target angle of 180°. From my altitude of 2,600ft I accelerated to Mach 1.35 then pulled up, very gently, continuing to accelerate to between Mach 1.7 and Mach 2.0, topping out at between 60,000 and 65,000ft. All the target data was on my map display, including radar detection of the target at maximum range, which then locked on immediately afterwards. I simulated missile launches – the closing velocity was very

high, between Mach 4.5 and 5.0; the SR-71 was flying at Mach 2.98 and 70,000ft. I had visual contact.

In total I have five hot intercepts against the SR-71 to my credit. All can be described as successful. I was visual three times; on a couple of occasions the SR-71 was contrailing, which was very useful because you could do a visual check to ensure you ended up in the right spot!

When we began conducting these SR-71 intercepts, the squadron began a special air safety programme and we all underwent an intense series of emergency procedure checks in the simulator, because we were flying at the outer edges of the envelope and at higher risk.

On 9 January 1986, while leading a JA 37 three-ship in aircraft tail number '38', we received target data immediately after take-off from Bravalla. We flew in trail, receiving updated target information over the link from both the fighter controller and the other fighters in the formation. All three of us carried out successful intercepts between 1:14 pm and 1:25pm, about 50km west of the town of Visby, on the island of Gotland. Major Moller was number two, in tail number '60', and Captain Ulf Johansson number three in tail number '53'.

I remember that the SR-71 was flying at an altitude of 72,000ft and a speed of Mach 2.9. Ulf had some difficulties coming back to earth – he actually reached the target's altitude and passed the SR-71 head-on at the same altitude with some side separation, but suffered a high temperature engine stall! A cartoon drawn by SAS Captain Stefan Lofren to commemorate this event was used as a poster in our briefing room.

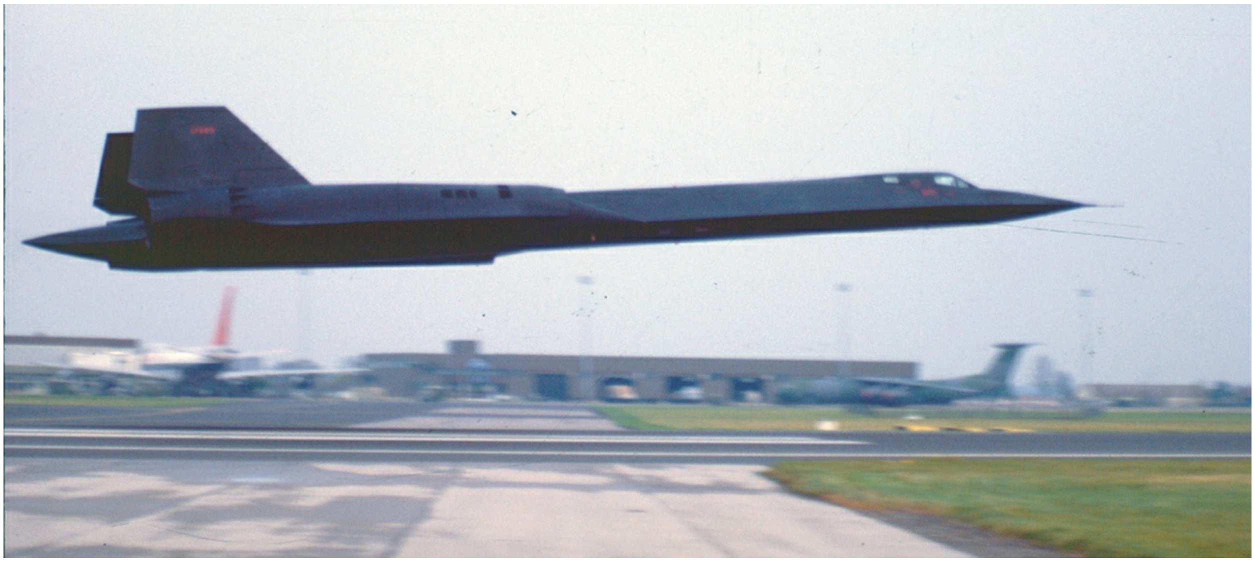
With both engines now producing full afterburner Truly 55, SR-71 '960, accelerates rapidly down the Mildenhall runway. (Paul Crickmore)

It's apparent that intercepting a Habu was an extremely difficult undertaking, and that's with the aircraft adhering rigidly to pre-agreed PARPRO tracks. In times of war, the SR-71's route would have been far more varied, making the calculation of a successful intercept solution more complex and therefore even less likely.

ENGINE FIRE

Whilst TDY with Det 4, another crew found themselves in a potentially catastrophic situation, as Ted Ross recalls:

> My pilot Major Jim Jiggens and I were assigned a double loop Barents/Baltic Sea operational mission for Saturday 7 March 1987. On the Friday morning I spent several hours in the Detachment mission planning office, noting sensor action points for the TEOCs (Technical Objective Cameras), in the left and right chine bays and the SLR (Side Looking Radar) that we'd be carrying in the nose on the next day's mission. In addition I calculated the exact points along the mission route where our pre-approved, diplomatically coordinated, emergency alternate landing fields would change, should any inflight emergency require an immediate landing. Little did I realize at the time how important this routine mission planning action would turn out to be. My planning philosophy was 'There is no such thing as being over prepared', so try and consider everything you can at 'groundspeed zero' in advance. That way, hopefully any necessary decisions at 2,000mph have already been considered and therefore become almost automatic in flight. Jim came to the Det that afternoon and we discussed the details of our upcoming mission, the 'take areas' where our sensors would be running, our planned refuellings, emergency airfields, etc., and as we had both flown these types of Barents/Baltic missions numerous times before, we both felt comfortable with our mission preparations. We then left the Det for our BOQ (Bachelor Officer's Quarters) rooms, for dinner and a good night's rest before our early morning getup the next day.



Truly 55, aircraft '960 flown by Majors Jim Jiggens and Ted Ross, makes a slightly lower than usual go-around, having returned from an operational mission. Jiggens was a member of the Thunderbirds aerobatic display team prior to joining the Senior Crown programme. (Paul Crickmore)

Sheik 99, SR-71 '964, departs Det 4 for another operational sortie into the Barents Sea. (Paul Crickmore)

At what seemed like the middle of the night, or as I called it 'oh-dark-thirty,' we were up, cleaned up, breakfasted and off to the Det Ops building for the pre-mission, intelligence, weather, and maintenance briefings. We checked the aircraft forms for SR-71 '964, to confirm it was 'ready for flight'. I double-checked we were carrying the TEOCs and SLR sensors. Jim and I both passed our pre-flight physicals, then we headed to PSD, to don our David Clark S-1030 full pressure suits. Meanwhile our mobile and back-up crew Majors Terry Pappas and John Manzi headed out to our aircraft to accomplish all the pre-flight checklist items up to engine start. Once Jim and I were in our pressure suits and had successfully passed the suit pressure leak checks, the PSD technicians drove us out to '964. Our mobile crew confirmed that everything looked good, we shook hands with them, then Jim and I climbed into our respective cockpits. I attached my boot spurs to the ejection retractor cables at the base of my ejection seat. Then I sat down, placed my arms up on the canopy rails, which was the signal to the PSD technicians waiting on each ladder beside my cockpit, that I was ready for them to connect my communications, oxygen, parachute, shoulder and lap-belt harnesses, then remove the ejection seat and safety pins. With everything connected and accomplished in my cockpit, the PSD guys stood aside and our maintenance crew chief handed me the three landing gear safety pins, which I also securely placed in their rear cockpit storage – although I did not realize it then, I was going to need those safety pins later in the day. The PSD guys then lowered my canopy, I locked it closed, gave them a thumbs-up, they then climbed down the ladders, and I advised Jim that I was ready with the engine start checklist when he was ready.

Our maintenance crew chief gave us the all clear for engine start and we fired both engines up and taxied out of the hangar into the dark behind our mobile car 'radio silent.' We checked both engines at military power near the end of the runway while our mobile crew zig-zagged down the runway checking for FOD (Foreign Object Debris) with their headlights, then they cleared the runway near the control tower.

S/N 029
JIGGENS
MAJ
JIM JIGGENS

On 7 March 1987, Majors Jim Jiggens and his RSO Ted Ross were forced to abort '964 into Stavanger following an engine fire. (Paul Crickmore)

ROSS
MAJOR
TED ROSS

The team responsible for recovering '964 from Stavanger were, from left to right: Tim Rice, Ralph Doull, Irv Bollendorf, Rick Artz, René Laurencot, Roger Spaulding, Andy Andrews, Art Enck, Dale Edminster, Danny Burns, Robby Butterfield and Jim Rush. (USAF)

After a green light from the tower (again radio silent operations) we pulled onto the runway. At our exact scheduled take-off time, Jim lit the afterburners and the 'rocket ride' began. I was slammed back into my seat from 68,000lb of thrust from our two J-58 engines. We roared down the runway, the nose gear lifted off seconds later, then the main gear, and we climbed at what feels like straight up.

Within a couple of minutes, we levelled off at FL250 (25,000ft) and headed towards the North Sea for air refuelling with our first set of two KC-135Q Det 4 tankers which had taken off hours before us. I brought up our unique secure Comm 3 UHF radio, which gave Jim and I a range and bearing to our tankers orbiting at the ARCP, awaiting our arrival. With the rendezvous completed, the tanker's boom operator connected us to his air refuelling (AR) boom and we were then able to talk securely to the tanker crew via interphone.

Air refuelling was the only time when the rear cockpit workload was calm enough for me to grab a drink of Gatorade that I'd brought and to eat a tube of peaches (my favourite inflight SR-71 meal). As we were air refuelling up off the western coast of Norway, I monitored our progress and paced our fuel onload by directing the number of booster pumps the tanker was using to transfer the JP-7 fuel to us. Each of our two tankers was single offload capable (80,000+ pounds of JP-7), should either have a transfer problem, even though we normally took half our fuel onload from one tanker and the remaining half from the other.

Nearing the end of our planned AR, I continually directed our second tanker to reduce the number of boost pumps they were using, until we were down to one, to guarantee we arrived at our end air refuelling point (ARP), absolutely full of fuel (80,000lb of JP-7). This was unique and critical in all operational SR-71 missions, because you had to be able to make it to your next scheduled air refuelling track or planned landing base. A few operational SR-71 missions were aborted mid-mission, because they were unable to make it to the next ARP, especially when outside temperatures at speed and altitude were much higher than expected (not uncommon in the Barents above the Arctic Circle, as the first two missions ever flown there were aborted early for unexpected high temperatures at altitude and the SR-71s were running well below the necessary fuel required to make it to their next ARP).

We dropped off the second tanker with our full 80,000lb of JP-7 onload and went into afterburner to start our acceleration to Mach 3. We flew up the western coast of Norway, crossed the Arctic Circle and then turned east, crossing northern Norway. At Mach 3 we levelled off above 70,000ft and Jim pushed ’964 out to Mach 3.2 while I conducted a self-test of our DEF (defensive) systems, as Soviet fighter intercepts were not uncommon in the Barents Sea. With all systems checking out, we slowed to Mach 3 and began our normal, 200ft per minute cruise climb.

Entering the Soviet Air Defence region, we began a large 360° turn back toward Norway, as our sensors imaged the Murmansk Soviet fleet area. While flying back across northern Norway and down its western edge, I again switched on our secure Comm 3 UHF system and it began ranging at 350 miles off our nose for our second AR. At a range of 200 miles, I directed Jim to start down, he eased the aircraft out of afterburner, and we began our descent from above 80,000ft to meet and rendezvous with our second set of tankers and conduct the second air refuelling of the day.

The rendezvous and second AR went as scheduled and at the end of our planned ARP and with another 80,0000lb of JP-7 onboard, we went back into afterburner and began our acceleration and climb for the second half of our mission – the Baltic Sea. We’d just turned due east towards the Baltic, south of Norway and at FL600 (60,000ft), still heavy with fuel, when the Master Warning caution light came on in both cockpits. Jim said, ‘We have a fire in the right engine’ and I immediately started directing us through the engine fire emergency checklist. We both knew that this was a ‘land as soon as possible’ emergency situation, and I told Jim that Sola-Stavanger off to our left was our closest, approved emergency alternate airfield.

We were literally falling out of the sky, heavy with fuel and the left engine in afterburner. Jim had the right engine at idle, but it was still indicating it was on fire. Jim shut the right engine down, which meant we lost two of our four hydraulic systems (R and B hydros). However, luckily the left hydro system provided normal landing gear extension and normal landing braking. But even when shut down, the right engine was still indicating that it was on fire.

Jim then activated the right engine fuel shut off switch and the fire light went out soon thereafter. While leading Jim through the engine fire emergency checklist procedures, I also called up the DP (destination point) in our ANS (Astro Navigation System), for Sola-Stavanger. I advised Jim to come left, and at his confirmation, I selected the Direct Steer mode on the ANS control panel. ’964 came left, and we both now had a range and bearing to Sola-Stavanger displayed in our cockpits. While I was directing the engine fire emergency and descent checklists, I transmitted our mandatory abort report, via long-range HF radio, so Det 4 would get word that ’964 was in trouble and aborting the Baltic Sea half of the day’s planned mission.

I contacted Sola Approach Control and advised them I was ‘a United States Air Force Tactical aircraft (we were not to broadcast we were an SR-71), declaring an inflight emergency, 15 minutes inbound your station, now passing FL450, requesting straight in approach for runway 36 to land.’ SOLA Approach control responded with ‘Say type aircraft, number of souls onboard, and type of emergency.’ I responded, ‘US Air Force Tactical, two souls on board with an engine problem.’ Again, came the request, ‘Say type aircraft.’ I responded, ‘US Air Force Tactical passing FL300.’ This time SOLA Approach said, ‘You aren’t going to tell me what type of aircraft, are you’, and they did not ask again. Jim and I were completing the single engine penetration and landing emergency checklist, and checked ATIS [Automatic Terminal Information Service] for weather at Sola-Stavanger, which was good, and noted that runway 36 was about 8,400ft long and almost 200ft wide.

As we were coming into land, I advised the tower that we’d be dropping three drag parachutes, two small and one 40ft, jettisoned on runway 36 during rollout and that they must be retrieved before any other military or civilian aircraft were cleared to land on runway 36 or 18. We were cleared to land and nothing more was said. Jim executed a perfect, single-engine landing, just as he’d practised at Beale AFB during many training missions, and as we pulled off the runway, Jim told me we had a ‘follow-me’ truck, which led us to a 110ft-long hangar, into which Jim taxied a 107.5ft wounded SR-71.

Before Jim could shut down the left engine in the hangar, I needed to get out and safety pin the landing gear in the fully down and locked position, before the L hydro system pressure bled off when the left engine was shut down. Remember those three, landing gear safety pins our crew chief back at Mildenhall had given me earlier, before the PSD guys closed my canopy – the ones I'd never used before, and was not really sure where they actually went (lucky for me it turned out to be obvious). I released myself from my parachute, shoulder and lap belts, oxygen hoses, boot retraction cables, then advised Jim I was checking off comm and then disconnected my communications cord.

Free of everything that kept me in the rear cockpit, I unlatched my canopy and pushed that heavy thing up. I then stood up in my seat and turned toward my left to see a Norwegian General and a maintenance trooper standing beside our cockpits to greet us. The Norwegian General's expression was priceless, I knew instantly he was looking at his first SR-71 crewmember in his full pressure suit, which he probably had no idea we wore. He might have thought aliens from outer space had arrived and he would not have been far from the truth, bearing in mind where the SR-71 normally operated! I used hand signals to the maintenance guy that I needed to get down and he brought over a step ladder and laid it up against the chine bay below my cockpit. I slid down the chine with the three gear pins, climbed down the step ladder, shook the Norwegian General's hand, then installed the three landing gear safety locking pins, and then signalled to Jim it was safe to shut down the left engine.

After he'd shut down the left engine and disconnected himself from everything, Jim climbed down the step ladder and also greeted the Norwegian General. Jim and I removed our helmets and gloves, and Jim told the General that our right engine had caught fire, requiring an immediate landing, and Sola-Stavanger, being in the southwest corner of Norway, was our closest pre-approved and diplomatically coordinated emergency alternate. Jim wanted to see the right engine, so the three of us started walking down the left side of '964 to survey the damage. On the way the General asked me, 'how long were we on fire?' I asked Jim and in a classic Jim answer he said 'Heck, we're always on fire, it's just supposed to only be coming out the back end!' He then said, 'I guess about five minutes total, until I activated the right engine fuel shut off', which seemed to satisfy the General's curiosity.

At the back end of the aircraft, we could see that what looked like a white ceramic burner cage which had come loose and shifted to the right, directing the afterburner flame towards the nacelle and right wing, damaging both in the process. After surveying the damage, we advised the General that we needed to close our cockpit canopies. We also requested his help in securing fulltime guards for the aircraft, as there was highly classified imagery and electronic collections of the Murmansk Soviet Air Defence region onboard and no one could be allowed hangar access except Jim and me until our own Det 4 personnel arrived to provide security. The General approved our request stating that no one except Jim and me would be granted access to the aircraft or hangar until the Det 4 recovery crew arrived, which we expected would be the following day, Sunday 8 March 1987.

Jim and I were then shown a room where we helped each other out of our pressure suits, and the General provided us with two Norwegian flight suits to wear, along with our over-sized boots we each wore when in the pressure suits. Jim asked the General if he could arrange for us to make a phone call back to Det 4, which he did. After Jim had explained everything to our Det commander, he was told that a KC-135Q would arrive the next day, with maintenance, security and recovery crew personnel, and that '964 would be back in the UK as soon as possible, and these assurances were relayed to our Norwegian General host.

The General then arranged for a bus to take us downtown to a hotel in Stavanger and the driver told us he'd be back to get us in the morning. The hotel was deserted and we were met by the only person there, a janitor. He explained that most of Norway takes the same two-week Mediterranean vacation each year and that we had the place to ourselves. We asked about getting rooms and he showed us a board on the wall, full of keys and he said, 'Pick any two you want.' The rooms turned out to be very small with very narrow beds, with a shared bathroom down the hall. Also in the hall was a cold sandwich machine, dispensing sandwiches at $15 each, a microwave and a soda machine with

Cokes costing $10 each, but lucky for us, the machines took US dollar bills, so I did get a dinner that Saturday night!

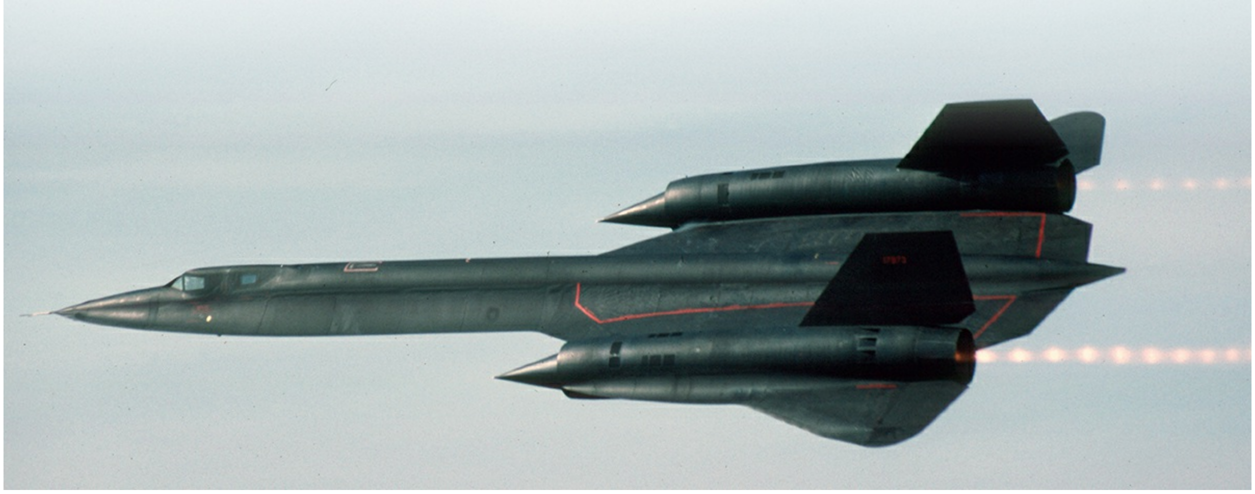
The next day we were back at the plane. The '135 from Det 4 arrived mid-morning and Lt Col Bernie Smith met Jim and me with clothes in our grab-bags. Jim and I returned to RAF Mildenhall later that day, leaving Bernie to oversee the repairs and recovery of '964 from Norway. Lt Col Smith and Maj John Manzi flew the aircraft back to Mildenhall subsonic 12 days later on 20 March. We were told that although there were plenty of spare J-58 engines, a C-5A Galaxy delivered the only replacement right wing section in existence. Once back at Mildenhall, '964 required extensive additional maintenance before it flew again supersonic.

Of note: the same day Jim and I aborted into Sola-Stavanger Norway in SR-71 '964, shortly afterwards the Concorde made its maiden flight into Norway also landing at Sola-Stavanger for a brief stay to test the viability of Concorde services to and from Norway. The next day (Sunday 8 March 1987), the local newspaper major headline was 'US Spy Plane Aborts into Sola-Stavanger' with an article that ran for three quarters of the front page. Down in the lower left corner, in a small box read, 'Concorde comes to Norway for the first time.'

A CLOSE CALL?

Throughout the Cold War, the Baltic continued to be an area of special interest to the armed services of the United States, including the Defence Intelligence Agency (DIA) and National Security Agency (NSA). As noted earlier, the first time that an SR-71 ventured into this lucrative 'collection area' was 1977; four more missions were completed in 1980. However, when in January 1981 Ronald Reagan became President and relations between the US and Soviet Union considerably deteriorated, the number of SR-71 missions into the Baltic that year soared to 32. This prompted the Swedish Air Force to begin referring to the flights as 'The Baltic Express'.

It was in 1983, following a further deterioration of relations between the two 'super powers' that President Reagan first applied the phrase, 'evil empire' to the Soviet Union, further raising the arms-race stakes. As a consequence, the number of 'Baltic Express' missions continued to increase, 30 in 1982, 40 were flown in 1983, 48 in 1984 and 61 in 1985. Seizing the opportunity, Swedish Air Force air traffic controllers and JA 37 pilots continued to hone their intercept skills, and by the end of 1985, they'd completed 31 PIs.



An overenthusiastic demonstration flight at the 1987 Mildenhall Air Fete resulted in '973 being overstressed. Palmdale crew Tom Tilden and Phil Souley ferried the aircraft back on 22 July 1987 – it never flew again. (Bob Acher)

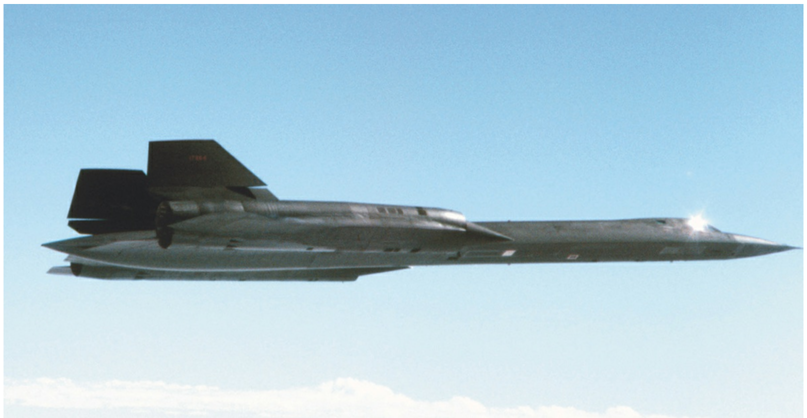
Majors Duane Noll and his RSO Tom Veltri are driven out to '964 on 29 June 1987 at the start of what potentially could have become an incident that delayed the end of the Cold War. (Paul Crickmore)

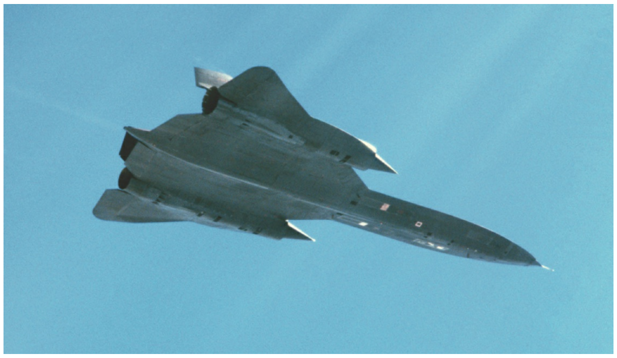
The Cold War began to thaw on 11 March 1985, when Mikhail Gorbachev became General Secretary of the Central Committee of the Communist Party. The British Prime Minister at the time, Margaret Thatcher, famously commented, 'I like Mr Gorbachev, we can do business together'. This was met by a commensurate drop in 'Baltic Express' missions to 46 in 1986 and 36 the following year.

On 12 June 1987, President Reagan visited west Berlin from where he made a speech that proved consequential in its audacity and serves as one of the signature moments during what proved to be the final stages of the Cold War. He challenged the Soviet General Secretary to… 'tear down this wall'. Nineteen days later, on 29 June 1987, Majors Duane Noll and his RSO Tom Veltri launched 61-7964 equipped with an OBC nose section, from RAF Mildenhall on a 'Baltic Express' mission. Flying with the autopilot slaved to the highly accurate Astro-inertial Navigation System (ANS), they'd completed their anti-clockwise run off the coasts of occupied Lithuania, Latvia and Estonia. Just prior to their scheduled left turn away from 'denied territory', Tom began a five-second countdown-to-turn (this provided the pilot with a timeline for possible manual intervention should the autopilot fail to initiate the turn). At 2:53pm, 90km east of the northern tip of Gotland and three seconds into the countdown, there was a terrific explosion in the aircraft's number 2 (right engine). Flying at Mach 2.9, the asymmetric thrust differential caused by this instantaneous loss of thrust from the right engine could have caused a violent yaw and catastrophic structural failure – were it not for the design genius of Kelly Johnson and his team. As per the plan, the autopilot immediately initiated a programmed unstart of the left engine. This belched the normal shockwave forward and out of the inlet, thus producing a similar loss of thrust, thereby eradicating a severe yaw. The result of course was that '964 could no longer sustain Mach 2.9 (the aircraft was flown at this reduced speed within the Baltic to ensure that its 30° turns remained within international airspace), nor could it maintain its altitude of 70,500ft. In such conditions the pilot's overriding responsibility is to control the aircraft. Duane Noll turned '964 tighter than normal, entering Swedish airspace at 2:56pm. The aircraft continued over Gotland and passed the southern tip of the island at 3:03pm.

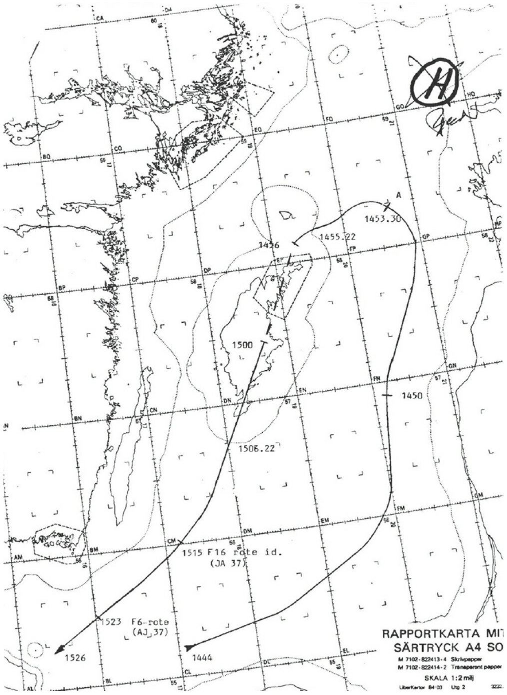
Tom Veltri recalls:

> As soon as it was apparent that we had a situation on our hands, I squawked emergency on our IFF – that got the Swedes' attention. We were losing altitude at a rate of 40,000ft per minute. Duane asked me for a heading. Given our circumstances, I thought only momentarily before saying '180'. We needed to go south and get out of there as soon as possible. We were now sitting ducks flying at just 350kt at 18,000ft. As we made our way south, Duane and I discussed a list of what ifs given our current plight, and we both decided that if necessary, we'd eject and take our chances in the Baltic Sea, rather than allow the aircraft and its technology be captured. As I looked out of my left window, the direction from which Soviet aircraft might come, I was concerned to see two aircraft at extreme distance closing.





These two images of '964 were taken from the cockpit of Lt Bo Ignell's JA 37 Viggen, following the SR-71's engine explosion. Note the position of the exhaust nozzle on the shut-down right engine and the rudders angled to compensate for the effects of asymmetric thrust from the left engine. (Lt Bo Ignell, Swedish Air Force)



A declassified Swedish Air Force radar plot showing the route details of '964 which clearly violated Swedish airspace during the emergency. (Swedish Air Force)

At 2:56pm, the Sector Operations Centre (SOC) at Rockan contacted Col Per-Olof 'P-O' Eldh, commander of the JA 37 Viggen squadron at Fighter Wing, F13 at Bravalla. He was informed that an SR-71 was in an emergency situation, had entered Swedish airspace and was descending. The SOC requested fighters to make a visual identification and provide an escort. The only fighters in the area were two Viggens piloted by Roger Möller and Krister Sjöberg, so P-O diverted them from their mission. The intention was for them to stay with the SR-71 for as long as possible. Thereafter, they'd be replaced by two armed QRA Viggens, taking off from Ängelholm.

Major Roger Möller recalls:

> Major Krister Sjöberg and I had performed a number of practice contacts when our 'targets' from F 13 Malmen had to abort and RTB. We decided to remain in the area and conduct a few more one vs ones. Suddenly our fighter controller asked if we were able to intercept and identify an aircraft of special interest. We immediately understood that he was referring to the SR-71 Habu. We knew the Habu's normal flight path between Öland and Gotland, and set a heading towards the south end of Öland, with a planned acceleration on a northbound heading to perform a 180° 'head-on attack'. I asked the fighter controller: 'State position' and he immediately said: 'Position is 30km north of Hoburg'. This sounded total nonsense, and I thought that he must have meant '30km north of Gotska Sandön'. After a short while I asked the controller again and he answered: 'Position is

Hoburg!'

I asked, 'Do you mean that he is actually in Swedish territory?'

'Yes', came the answer, so we rapidly changed our plans and accelerated to supersonic speed towards Holburg.

After a short while we got a radar lock-on the Habu but no visual, as there was a lot of cloud in the area of our target, who was flying at about 25,000ft. Suddenly the weather front ended, almost as if we had ordered visual flight conditions – and there he was!

Krister, my wingman, was on my right side. He made a fast stop on the Habu's right side, and commented directly, 'Det här var grejer'…This really is something!

We noticed he was running on one engine. I flew behind, and took the opportunity to stay on *top* of the SR-71, which was very unusual! After staying with the Habu for five minutes we were running short of fuel and I called Visby air base for a short stop and rapid refuelling. But I was informed that my request was out of the question due to maintenance and other aircraft in the pattern. We therefore had no other choice but to leave and RTB. We heard that the QRA-unit was inbound and left the mighty SR-71 to its destiny…

Lt Col Lars-Erik Blad now takes up the story:

I was the commander of the 62nd AJS, based at Ängelholm AFB, which is located on the west coast of the southern part of Sweden. This particular day I happened to be on QRA duty with my wingman Bo Ignell, a young pilot that had just passed his squadron training. We started our duty early in the morning and had our flight briefing. It was a foggy day with slight drizzle and the weather was not expected to improve during the day. I commented to Bo that we wouldn't scramble unless it was absolutely necessary as the weather was at landing minimal, and we risked not being able to land at Ängelholm again.

Lt Col Per-Olof Eldh of 2 Sqn Fighter Wing F13 'Martin Blå' leads Major Dag Jonasson and Captain Bo Larsson on a three-ship JA 37 fighter sweep over the Baltic east of Öland. (Lt Col Per-Olof Eldh)

An army battalion was going to practise at a firing range just outside Ängelholm, but as the weather was so bad they had to cancel their exercise so the battalion CO phoned and asked me if they could visit us and get briefed about our job. I approved their request, since I believed we were never going to scramble that day.

I had just started my briefing when we received the order to raise the alert level from 5 minutes to 1 minute. We jumped into our aircraft, contacted our fighter controller and were immediately ordered

> to scramble. As we cranked our engines we received information that our target was an SR-71 south of Gotland at 30,000ft, heading southwest and descending.
>
> We took off and climbed to roughly 25,000ft increasing our speed to Mach 0.98 to stay subsonic over land. Soon we were over the Baltic Sea and received further information regarding the speed and altitude of the SR-71. It was flying at slow speed and descending rapidly and we were closing up somewhere between Gotland and Bornholm. I reported that we had the aircraft visually and that we were well aware that they had problems. I was very careful not to surprise the crew on the SR-71 and therefore I decided to do a flyby quite slow, on their right side, making sure that the crew was aware of our presence. I made a 360° right turn and told my wingman to close up to the SR-71, while I stayed behind and above to ensure I had good situation awareness if anything should happen. We had no indication of other aircraft in our vicinity and we continued to follow the SR-71 until we were close to Bornholm and had to terminate our mission. As the SR-71 entered Danish and NATO airspace, we had no problems handing over the aircraft, hoping that it would safely reach their emergency airfield.
>
> Heading back to Ängelholm my wingman reported an electrical failure and I ordered him to go to our home base F6, in Karlsborg, while I returned to Ängelholm. Routine intel reporting followed with a strange feeling that we had experienced something that was extraordinary.

Tom Veltri continues:

> Given that the Soviets were monitoring our activity, I was glad to see a friendly escort, I can tell you! We later found out via the NSA, who were monitoring the Soviet response, that they'd launched numerous fighters with orders to either force us to land in Soviet territory or shoot us down should the opportunity present itself.
>
> The Viggens continued to escort us through the Baltic and along the Polish and East German borders until F-15s out of West Germany intercepted and took over escort duties, but we still weren't out of the woods. Denmark was completely fogged in so we had to continue to West Germany, since our inflight emergency and fuel constraints made it impossible to make it back to Mildenhall, we were therefore forced to land at Nordholtz AB, West Germany. The engine explosion had also caused the complete loss of our auxiliary hydraulic fluids, which meant that we had no brakes or steering on landing – making the possibility of not being able to stop on the runway highly likely. The base closed off all roads surrounding the base prior to our arrival in anticipation of our going off the runway. Fortunately for everyone, there was just enough residual hydraulic fluid left in the lines for one application of the brakes. The airplane stopped just short of the end of the runway and that's where we left it for the rest of the day until a maintenance crew from Mildenhall arrived and moved it to a hangar to receive further attention.

Outstanding airmanship had prevented the loss of a national security asset and both Tom and Duane were awarded Air Medals. When his assignment to the 1st SRS came to an end, Tom worked as a staff officer at the Pentagon. On seeing his name tag on his uniform, Tom was amazed at the number of people, even from the State Department, who knew about his Baltic exploits. One particularly insightful staffer from the State Department told him, 'You know you were really lucky getting that aircraft safely out of the Baltic. If you'd been forced to land in Soviet territory or shot down, it would have delayed the end of the Cold War for probably ten years.' Indeed, there have been many moments throughout history that a tactical event had, or could have had, serious strategic implications.

On 28 November 2018, at the US Ambassador's Residence in Stockholm the Swedish AJ/JA 37 pilots involved in the action 31 years earlier were each awarded USAF Air Medals in recognition of their meritorious service (unfortunately Bo Ignell was unable to attend). Pictured, from left to right: Per-Olof Eldh, Tom Veltri, Paul Crickmore, Roger Möller, Lars-Erik Blad and Krister Sjöberg. (Paul Crickmore)

POST SCRIPT

Tom wanted to personally thank the Swedish fighter pilots who'd provided the crippled Habu with an escort, undoubtedly keeping them from harms' way. However, anxious to guard their neutrality, the Swedish Air Force classified the incident as secret. But after 30 years, the veil of secrecy was finally lifted. Consequently, on 28 November 2018, at the US ambassador's residence in Stockholm, a poignant, moving ceremony took place during which the USAF honoured Col Lars-Erik Blad, Maj Roger Möller, Maj Krister Sjöberg and Lieutenant Bo Ignell (who unfortunately was unable to attend) each with the award of the USAF Air Medal, in recognition of their meritorious service 31 years earlier. During their briefing at Mildenhall prior to flying the mission, Duane and Tom were told that they were prohibited from diverting into Sweden to avoid an international incident. However, the Viggen pilots at the ceremony told Tom that they would have welcomed the SR and its crew.

CHECK-SIX!

At 10:10am on 3 June 1986, Maj Stormy Boudreaux and Maj Ted Ross left Mildenhall in ’980, heading out across the North Sea toward their first refuelling west of Norway, on another Barents/Baltic sortie. At 26,000ft in the refuelling track, they found the sun directly ahead of them and clouds all around as they closed for contact with the KC-135s in diffuse and strangely angled sunlight, which reflected brightly off the undersides of the tankers.

As soon as the boomer made contact, Stormy found himself flying formation in almost blinding conditions, with the SR-71’s cockpit instruments obscured (in the dark shadow of the dashboard below the windscreen), forcing him to arrange his tiltable car-like sun visor to shield against the high contrast conditions. That effort proved of little value for, while in the contact position on the boom, the tanker’s reference points for formation flying were flashing in such extreme contrast that they appeared to be surrounded by ‘sea or sky or whatever’. A strong sensation of vertigo overtook Stormy, leaving him with a false sense of diving and climbing (and with the even more powerful sensation of flying inverted while refuelling). An interphone call to Ted assured Stormy that he was not upside down; he was then able to continue filling ’980’s tanks while fighting his sense of flying ‘straight up or straight down’.

After clearing the tanker, and his senses, Stormy climbed through 60,000ft, where he noted through his periscope that ‘980 was still pulling contrails, which should have stopped above that altitude. Another check at 70,000ft revealed that he was ‘still conning’, which he hoped would surely stop before they approached their target area. Upon entering the Barents Sea zone, the aircraft began a programmed left turn to the northeast and then reversed in a large sweeping right turn to roll out on a westerly heading, which would take it on the collection run and back across the entry point. Established on the westerly heading north of Archangel, the crew noted that they were still ‘conning’, which was most abnormal at high altitudes. To add to their dismay, Stormy spotted three other contrails ahead of them and to the left, but turning to converge in what might be an intercept. Another southerly glance revealed more ‘cons’ closing from the left but at a lower altitude.

Mac McKendree, followed by Randy Shelhorse step from the PSD van en route to their aircraft and another SR-71 mission. (USAF)

Bob Archer was on hand to photograph '964 when Majors Mac McKendree and his RSO Randy Shelhorse departed Det 4 on route GR-104B, during which they completed three loops around the Barents Sea on 5 July 1987. (Bob Archer)

These six Soviet fighters, each separated by approximately 15 miles, were executing what appeared to be a well-rehearsed turning intercept manoeuvre to pop up somewhere in the vicinity of the fast-moving Habu and fire off some sophisticated air-to-air missiles. The Soviet fighter pilots had executed an in-place turn, which would have put them in a perfect position for a head-on attack had ’980’s track penetrated Soviet airspace. As Ted monitored the fighters’ electronic activities, Stormy increased speed and altitude.

Suddenly a contrail shot by just beneath the nose of ’980, leaving both crewmembers waiting for a missile or another aircraft to appear that might have ‘spoiled their whole day’. It was with great relief that Stormy realized they were now paralleling their inbound contrail, and the contrail they had just crossed was their own, laid when they turned northeast before heading west. For a few moments their hearts missed several beats at the thought of having unwanted high-Mach company 15 miles above the cold Arctic seas.

Stormy eased off some power and settled back into their routine of high-Mach cruise. The autopilot completed a long ‘lazy turn’ around the north shore of Norway before Stormy started his descent towards another refuelling. To complete the mission, the crew made an easy high-altitude dash into the Baltic corridor and down through West Germany before heading home to Mildenhall.

SR-71 ‘980 completed its fourth and final deployment to Mildenhall between 27 July 1987 and 3 October

1988. It's seen here in the static display at the 1988 Mildenhall Air Fete. (Paul Crickmore)

ANOTHER CLOSE SHAVE

During the late autumn, the Det again came within a breath of losing an aircraft, as Larry Brown explains:

Captains Larry Brown (left) and his RSO Keith Carter were another SR-71 crew to enjoy the hospitality of the Norwegian Air Force, after they were forced to divert '980 into Bodø on 20 October 1987. (USAF)

Keith and I were scheduled to launch at 5:30pm local time for a Barents mission on the evening of 20 October 1987, in aircraft '980. There was weather forecasted in the refuelling area off the coast of Norway; this was our first tour to Det 4 so we were the new guys. Mike Smith and Doug Soifer were actually scheduled for this mission, but due to a conflict with another activity we swapped flights.

Launch went as scheduled and the aircraft performed well throughout as we exited the sensitive area. Our descent profile into the last refuelling track was going well with our altitude profile in check. So far, a great mission. We had a good lock-on with the tanker's ranging system and fuel was above planned. Just one more hook-up, accel, and we'd be back on the ground in no time, or so I thought …

Decelerating through Mach 1.3, we completed our final decel checklist. Altitude was on profile and as we passed through 31,000ft, the triple display indicator showed us decelerating through the Mach to subsonic speed. 'OK Larry, range 40 to go, ready with the refuelling checks,' Keith said. 'OK, go with the checks.' By level off at 26,000ft, we had completed our refuelling checks and now we could concentrate on the rendezvous. Our range to the tanker quickly counted down to 20 miles as the tanker made the final turn that would put us in trail and on the same heading. There was no moon or horizon and everything outside looked pretty black. At 10 miles range, I picked up the tanker's lights, which were in a left turn about 10° off the nose. At 5 miles, I began a slow descent to their altitude of 25,000ft.

The tanker had just about rolled out on heading and I began to slowly retard the throttles back to begin slowing from 0.9 Mach. Moments later I heard something through my earphones that seemed to be a high-pitched buzzing sound, similar to the sound when switching the generators on after engine start during ground operations. Immediately, the master warning light illuminated, signalling me to check the tele-light panel. I glanced down to discover an amber 'R GEN OFF' light illuminated, indicating that the right engine-driven AC generator had disconnected from the main bus. In the SR we had two AC generators, each driven by its respective engine. The electrical system, as with other aircraft, was designed with an AC bus tie to allow the other generator to power the AC electrical requirements in case the other dropped offline.

All buttoned down, 61-7964 prepares to leave the Det 4 barn on a Barents/Baltic Seas mission on 17 December 1987. Ground technicians would have begun their activities 4½ hours earlier. Their first task was to warm the tar-like engine oil prior to start up, which in UK winter temperatures cooled to a solid mass. (Paul Crickmore)

SR-71 '964 awaits clearance to roll on 17 December 1987. (Paul Crickmore)

My first reaction was to look back up at the tanker. I was at their altitude with closure speed and needed to first stabilize our position behind them before working our problem. As I stabilized behind the tanker, I told Keith we had a right generator off light and he responded that we had also lost the ANS, which was our primary navigation system. We went ahead and hooked up with the tanker, taking on 5,000lb of fuel before disconnecting.

The nature of a single generator out was not a serious emergency, especially since the other generator had picked up the load. I knew we had two chances to reset it; otherwise it was mandatory for us to land as soon as possible. After going through the checks, the generator dropped off again and then again. Now we had no choice but to divert to Bodø, Norway. We explained to the tanker crew the nature of our problem and directed them to proceed to Bodø. I elected to remain on their wing until we had everything ironed out before taking the lead. Since the tanker had a good platform and navigation system, the choice was simple to keep them in front, especially considering the solid deck of weather, night and no moon!

We again hooked back up with the tanker for an additional 10,000lb of fuel – one thing I didn't need was to make a poor situation even worse by running low on fuel, just in case we had to go somewhere other than Bodø. I then slid back on the tanker, flying a loose formation. We finished up our checks and prepared for the approach, setting up the ILS and TACAN. We were still too far out for a check on the ILS and our TACAN wouldn't lock on, but the INS seemed to be OK. One of our UHF radios was on the tanker's frequency and the other with ATC.

With 70 miles to go, I could see we were too high and tried to communicate with the tanker, but with no luck. I kept trying, but got no reply and we were not receiving ATC either. Fuel looked good at 28,000lb but the CG was getting aft, so I began to transfer fuel to the forward tanks. We then tried the VHF radios and guard, but again, no luck. As we penetrated the deck, the tanker began a left turn away from where I thought we should be heading; now I wasn't sure if Bodø was closed, or if the tanker was just circling to get down. We were getting ready to try them on the HF radio when we heard them over guard, 'come up on victor 127.0.' Having finally made contact, I planned on getting a position check, but then things really took a turn for the worse.

The pinnacle of Soviet SSBN design was epitomised by the enormously powerful Akula (Shark) class boats (NATO reporting name 'Typhoon'). Built at Shipyard 402 in Severodvinsk, with a submerged displacement of 48,000 tonnes, they were armed with six torpedo tubes and 20 R39 SLBMs, each containing 10 Multiple Independently Targeted Re-entry Vehicle (MIRV) nuclear warheads. Six were originally constructed, and to date they remain the largest submarines ever built. (Bellona Foundation)

SR-71 61-7967 flares for landing at Mildenhall after completing a functional check flight on 20 November 1989, following termination of the Senior Crown programme. Note the panoramic nose section. (Bob Archer)

As detachment commander at the time, it fell to Lt Col Tom Henichek to reluctantly officiate at its deactivation. His obvious fatigue says much about the thoughts of the HABU community at the time (Paul Crickmore)

The floodlights suddenly came on, making it extremely bright in the cockpit and very difficult to see the tanker. At about the same time that familiar buzzing sound came through my headphones. I immediately looked down at the telelight panel to discover a host of amber caution and red warning lights. The two red warning lights that caught my attention were the LEFT and RIGHT ENGINE FUEL LOW PRESSURE lights, indicating loss of our remaining generator and imminent engine failure. I immediately placed both generator control switches to the emergency position as called for by the bold face procedures. Keith, also aware of the failure, called out the bold face actions without hesitation. Now, I went from bright floods to very dim lighting. However, my immediate concern was the back-up AC generator system (also known as emergency generators) and the supply of AC power to the fuel tank boost pumps ensuring fuel pressure to the engines. I quickly looked down to where my fuel control panel was supposed to be located, but the entire panel was black, with no lighting whatsoever. To further complicate matters, none of the fuel tank selection buttons illuminated, either because the pumps were tripped off or no power was going to any of the status indicator lights. I then remembered a warning in the manual stating that during emergency AC operation, the normal auto fuel sequencing system is disabled and the pilot must manually select the tanks.

Auto transfer and ullage systems would also be inoperative. I felt across my panel until I located the tank selection buttons, then beginning from the top I counted down, including the cross-feed button, to the fifth button and pushed it in, which was tank 4. Tank 4 had the most fuel, and feed from this tank would have less impact on the centre of gravity. I still had no tank 4 ‘ON’ light but observed that both red LEFT and RIGHT ENGINE FUEL LOW PRESSURE lights went out, indicating at least some of the four boost pumps in tank 4 were operating and supplying adequate fuel pressure to the engines.

Now, at last, I had a chance to assess our situation. We were still over water, north of the Arctic Circle and it was hours before sunrise – this would make for a very serious situation if it became necessary for us to bail out. In the SR-71, fuel boost pumps are required to sustain engine operation.

These pumps operate under AC voltage and required high enough current that only the engine-driven AC generators could deliver. If one generator failed or dropped offline for any number of reasons, then the electrical crossover system provided AC voltage from the remaining AC generator. However, if a failure also occurred in the other AC generator, then the boost pumps failed to supply fuel to the engines. To guard against this remote possibility, an emergency back-up feature was installed. It allowed the pilot to switch over to a more direct routing to the generator, or what was termed 'emergency generator'. If one or both generators were intact and producing some amount of current, then this emergency 'bypass' system would allow you to tap into any AC power coming from them. This emergency mode was intended as a last resort in order to provide unregulated and reduced power for running certain critical components necessary for flight. In the case of a non-rotating or seized generator, then no power would be available to power the boost pumps.

We were now operating on emergency generator power with sufficient AC current for fuel pump operation. We were still in the weather, flying formation off the tanker, but had dropped back near my visual limits with it. I reviewed our status with Keith. The RSO's cockpit didn't have a telelight panel, so I needed to keep Keith informed. I then told the tanker that our situation had gotten worse and we needed to get over land. It was hard to believe we had two totally independent failures; I was convinced there was a single failure at the root cause of all this.

I shifted my attention to what we had working, while the tanker continued the descent through the weather. Keith said he was in a totally dark cockpit with no lights, no INS information, no navigation and no radio control! I had a faint light on my airspeed and heading indicators, but the rest of my instrument panel was dark. I knew that under emergency power I was supposed to have boost pumps, cross-feed, CG and fuel indicators, together with pitch and yaw trim. I also knew that my DC essential bus and the AC emergency bus (different from the back-up emergency AC system to run the boost pumps) were being powered by either the number one battery or one or both of the transformer rectifiers. With the emergency AC voltage high enough from the generators, then the transformer rectifiers would power the emergency AC and essential DC buses: if not, then they would only be powered by the number one battery, which would only last for a very limited time.

My VHF radio was another concern, as was the intercom for talking with Keith. Cross-checking my telelight panel I saw that the 'EMER BAT ON' status light was not illuminated, indicating I had good AC voltage from my emergency generators. Both transformer rectifier lights were also out, assuring me I had good DC voltage to run my essential DC bus. My instrument inverter light was ON, which was supposed to be the case for this condition. These status lights indicated the electrical system was operating as designed while under emergency power. I could now see that the tanker had increased the descent rate and was still in an orbit, but I couldn't see any coastal lights.

We had been operating under emergency AC power for about 3 minutes and things at least looked stable. It would just be a matter of picking up the coastal lights and then manoeuvring to final approach and landing. I was about to ask for our position and heading when the red master warning light illuminated again. This can't be good, I thought. Checking my telelight panel, I discovered the left generator fail light was on, indicating we had a complete loss of the left emergency AC back-up system, probably due to a seized generator. I made a call to the tanker that we were down to our last source of emergency AC power. ATC informed us that a rescue helicopter had been dispatched.

We went from a simple single generator failure to losing our nav and radios, then losing the right generator to losing the emergency left generator system. Out of four AC generator modes, we had lost three of them and were now down to our last one, and all within 15 minutes! There was no reason to believe that the remaining right generator would not completely fail. I still couldn't make out the coast, or for that matter a horizon. I asked for range and bearing to Bodø and ATC replied with 'on the nose for 25 miles'.

With the left generator completely gone, I knew I had lost half my tank 4 boost pumps. Pumps 4–2 and 4–3 were now without power, leaving me with just pumps 4–1 and 4–4, basically one pump for each engine. I wasn't sure of the voltage or current output of that remaining AC generator. If it was too low, then the boost pumps might not have sufficient AC power to meet fuel demands under the high engine power settings required during approach or go-around. The fuel cross-feed valve had been selected open, but there was no light to indicate that it was functioning. I selected tank 2, but there was no light to indicate that the pumps were operating.

A press conference was held within the Det 4 operations building following the earlier departure of '964. Here Majors Don Watkins (left) and his RSO Bob Fowlkes are seen answering questions. They ferried the last SR-71 to leave the UK ('967) back to Beale the next day. (Paul Crickmore)

Finally, I made out the surrounding lights of Bodø air base. I still could not read most of my indicators. I lowered the gear as soon as I was sure of making it to the coast. Thankfully, all three green gear down and locked indicator lights came on. I knew I didn't have a taxi light, but at least I retained control for deploying the drag 'chute. At about 10 miles from Bodø, I picked up the runway, cleared the tanker off and manoeuvred to about a 5-mile final. I wasn't sure of my exact speed, but kept it high in case I lost an engine. Over the overrun, I brought both throttles to idle, touching down about 1,500ft down the runway. With a good 'chute we came to a stop about 5,000ft down the runway. The time was about 8:50pm local.

We radioed the tanker that we had landed safely and they in turn informed the tower; they couldn't see us since we had no exterior lights. After tuning to the tower frequency on VHF, we were able to communicate and coordinate our movement around the airfield. Keith and I were pretty glad to be on the ground! We taxied to a remote hangar, where we shut down and were greeted by an officer overseeing the operation. Now we were safely down, the security of the aircraft and the take was our priority.

Norwegian military security personnel were soon on the scene, and they brought with them about a dozen very well armed guards. We instructed their officer in charge that no one other than Keith or myself was allowed past them into the secure zone. They secured the perimeter with armed guards all in view of each other. Keith and I felt confident it was safe to leave the aircraft and its valuable intelligence cargo.

We were then transported to their command post, where we were patched through to our operations post at Mildenhall. We had a lengthy discussion with maintenance describing the extent of our problems. No doubt, they were at a loss as to what systems could have failed to that extent, and what they needed to bring over with them. Afterwards we were given rooms at the officers' quarters, along with some 'flights' to wear and an invitation to join the base commander at his table for dinner.

The following day a KC-135Q arrived from Mildenhall carrying our maintenance and security personnel and, most importantly, our personal belongings. I always had a 'grab-and-go bag' with all the necessary clothing in my room just in case of a landing away. I was also glad to see they'd included a generous amount of refreshments, which were very expensive in Bodø! We had an access list of all personnel allowed into the secure area, which Keith and I reviewed. We then coordinated with the Norwegian officer in charge to transfer security over to our military security personnel. Keith and I were very grateful to our Norwegian friends, and we were certainly impressed with their ability to respond with such little notice and with such a high degree of professionalism. Every detail was covered, and we were treated with the utmost courtesy.

During the next four days of our stay, Keith and I went out to the hangar to check on progress and help out, including conducting engine runs. It looked like it was going to be ready for the flight back to Mildenhall on 24 October. I was hoping for a daylight departure, but system checks took a bit longer than anticipated, so we finally launched out of Bodø that evening for the night subsonic return to RAF Mildenhall. Although we had a little apprehension about the reliability of the electrical systems, the aircraft flew quite well with no abnormal occurrences. The aircraft was put right back on schedule after a few more checks, once again demonstrating what a superior ground crew we had; it was a real test of our capability.

Lt Cols Tom McCleary and his RSO Stan Gudmundson arrive at the barn and make a beeline for the team of ground technicians to thank them and bid them farewell. (Paul Crickmore)

POST SCRIPT

During the tear down, maintenance discovered we had suffered two completely separate failures. The loss of the right generator was due to a failure of the right voltage regulator, while the loss of the left generator was due to a failure in the accessory drive unit. This failure of the left side caused the generator to seize and would have also resulted in complete left utility hydraulic failure. I guess it was fitting that on 18 January 1989, Keith and I flew our last SR-71 flight in aircraft '980.

AN UNAUTHORIZED AIR SHOW

Mac McKendree talks about the day he was requested to perform an 'aerial

salute,' for an ex-HABU that came back to bite him.

When I left the Air Force, I spent ten years flying for UPS – hauling rubber dog poop out of Hong Kong (I got the job Tom Cruise didn't want). So, in the middle of a night stop, I join a table where I'm introduced by a friend. 'This is Mac and he flew SRs.' One gentleman's response was, 'Man, let me tell you! I was in the Runway Supervisory Unit (RSU), and this SR came roaring into Bentwaters and just beat the hell out of the pattern!' So, I sat down and told him the rest of the story.

In February 1988, fellow SR pilot, Lt Col Les Dyer, had a follow-on assignment to RAF Bentwaters, flying the A-10 Warthog. Word came down that he'd been selected to become Squadron Commander of the 510th Tactical Fighter Squadron (TFS), and the change of command from Lt Col Jim Elliot was going to take place on Tuesday 1 March. Lt Col Nevin Cunningham, the Det 4 Commander, had received a phone call from Les (being fully aware of the SR's normal operations), wondering if it was possible to have the SR 'swing by' after a [Giant Reach] GR Barents mission, during said ceremony. Randy Shelhorse my RSO and I were flying that particular sortie and heartily agreed – after all, it was Les!

We completed route GR-106D and as planned, filled '964 with an extra 10,000lb of fuel from the last tanker to ensure we had enough to cover our additional needs. We requested a practice PAN [practice emergency diversion] into Bentwaters and planned to fly a low approach and then climb out and return to Mildenhall. The weather inbound was absolutely terrible, with heavy rain and thunderstorms over the North Sea. We finally got established on the ILS and broke out of the clouds to a beautiful day.

Handed off from approach control to the tower, I checked in with our intentions and made our request back to Departure Control, for our return to base. The tower replied, 'Working on your clearance. Can you stay in the closed pattern? Right circuit at 1,500' no other traffic.' After a number of normal closed patterns (normal for us, but never seen here), and with still no clearance for departure, I'm running out of landing gear cycles (the limit was ten). So 'Base, no gear, low approach,' became my radio call!

Tower finally gave us an IFF, frequency, and altitude for our return, adding, 'You see those two A-10s approaching the arming area? [the arming area is next to the runway, where all final checks are conducted prior to take-off]. That's Col Dyer. He hasn't seen you yet.'

The unit's change of command ceremony was quite unique, where the outgoing and incoming commanders take off as a two-ship and perform a lead change on initial climb-out. It's pretty cool!

So, turning Final puts me head-on to the A-10s at the end of the runway. Admittedly, my fangs are extended. So, rolling out over the runway, I stroked full AB and pulled into the climb.

On 18 January 1989, Lt Col Tom McCleary rotates '964 off the Mildenhall runway for the last time. With the programme having been terminated six weeks earlier, it was a master stroke calculated to catch the Soviets off-guard, sending the aircraft home via an operational sortie into the Barents Sea. (Paul Crickmore).

Returning to Beale after this TDY, Randy and I were summoned to the Wing Commander's office. It seems that the Wing Commander at RAF Bentwaters had called Col Richard Graham our 9th SRW commander, to thank him profusely for the magnificent SR-71 flying display. It seems he said he'd been trying for years to get an SR at their air shows. And it only took a phone call from his new squadron commander to get it done. Thank you, thank you, thank you!

So Rich asks: 'Did you do burner closed patterns?'

Me: 'No Sir. I did use AB on departure.'

Rich: 'You both are grounded for 30 days.'

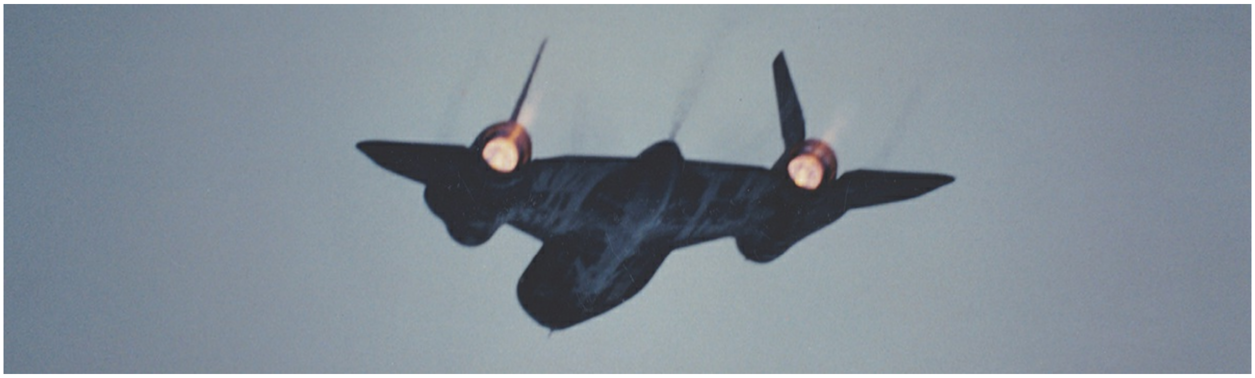
A month later I'm airborne in a T-38. In the back seat – Col Graham!

MORE NORWEGIAN 'ADVENTURES'

Bodø again became the temporary home of a Habu on Saturday 13 February 1988. Maj Mac McKendree and his RSO Maj Randy Shelhorse had completed the planned double loop around the Barents collection area in compliance with route GR-104G, when their Exhaust Gas Temperature (EGT) reading climbed too high. Since continuous running in this condition causes serious damage to the engine, it's a mandatory 'land as soon as possible' item in the checklist. So Mac brought '964 into land at Bodø, after a 3.7 hours flight. Once the recovery team from Mildenhall had worked their magic, '964 was returned to the fold two days later, landing 2.8 hours after take-off.

On 5 July 1988, the ninth and final diversion into a Norwegian air base took place when Maj Tom Danielson and his RSO Lt Col Stan Gudmundson, known within the crew force as the 'Son Twins' (because their surnames end with 'son' and they look completely different from one another), departed RAF Mildenhall at 0800(L), in SR-71 '980 using the callsign Quid 38. As Tom recalls,

> As normal, we accomplished an afterburner climb to 25,000ft. We then started 'secure' range and bearing to our prepositioned KC-135Q tanker. After rendezvousing, we had full tanks exactly at the designated End Refuelling Track, as planned. Specifically, for Blackbird refuelling, the tanker turns away, while the SR-71 begins a straight-ahead acceleration manoeuvre. After initially achieving supersonic flight, we began a climb while continuing to accelerate. The accelerating climb usually required several hundred nautical miles. We usually began our initial 'cruise climb' at Mach 3.0+ and about 75,000ft MSL. At the end of our cruise leg and prior to descent to our tanker, we were at over 80,000ft.



Majors Don Watkins and his RSO Bob Fowlkes flew '967, the last SR-71 to leave the UK, home to Beale on 19 January 1989. The weather was in keeping with the event, cold and grey. (Paul Crickmore)

> This particular mission had us north and east of the northern coast of Norway in the Barents Sea. Continuing east shortly after entering the 'sensitive area', I used our intercom system to inform Stan that we had a left engine fire light. He immediately directed me to turn left to (heading) 180°. We immediately began running multiple checklist procedures. We certainly desired to do what we could to extinguish the fire warning while concurrently accomplishing a single-engine descent procedure. While all this was going on, Stan was broadcasting our abort on HF radio. This was primarily since many additional agencies and aircraft were in support of our operational mission and they needed to know ASAP, so our supporting aircraft could also air abort.

Two SR-71 nose sections are seen stacked and awaiting transportation back to Beale from RAF Mildenhall following the termination of Senior Crown. (Paul Crickmore)

After the HF abort was acknowledged, our only remaining job was to recover and land our irreplaceable jet. During the initial descent and after determining that I could not get the fire light to extinguish, I shut the left engine down. After descending and slowing to single-engine cruise, we were at about 15,000ft and 300 KIAS. Fortunately, this was in July, so we had plenty of daylight. Our nearest suitable airfield was nearly an hour away. Because of our single-engine descent which started above Mach 3, our descending flight path looked like a large 'button-hook' to the north. We ended up closer to the geographic North Pole than the north coast of Norway. After levelling near 15,000ft, I commented to Stan that there was the polar ice cap below and numerous icebergs immediately south and that if the operating right engine caused problems, I was going to restart the bad left engine to get as far south as possible as I knew that if we had to eject, we would freeze in the very cold Arctic Ocean long before any possible rescue.

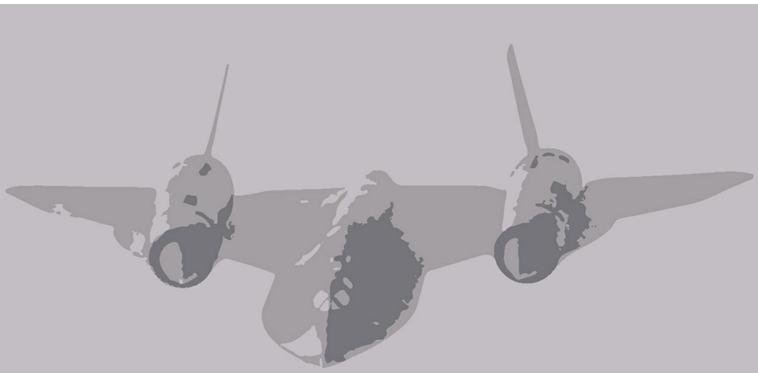
After about an hour and ten minutes, we finally got to Andoya. The flight manual lists a 'demonstrated' crosswind landing limit of 29kt. The report at Andoya showed a crosswind component of 35kt. Since we were NOT going to continue flying on one engine for another hour-plus to Bodø Airbase, I decided to land above crosswind limits at Andoya [they touched down at 3:41pm local – 13:41Z].

Of course, it happened to be a summer Sunday. There were only two Norwegian Air Force staff working. Fortunately, the Control Tower Controller spoke perfect English. Unfortunately, the Transient Alert Guy (Aircraft Parking Person) did not speak any English. Our flight manual procedure calls for us to NOT jettison our drogue 'chute whenever the crosswind exceeds 15kt. We normally jettison the drag 'chute at 65kt during landing roll. Our normal approach speed is 175kt, plus a fuel additive. Of course, I could not jettison the drogue 'chute. Also, as Andoya had large snow lights along the taxiways and the Andoya maintenance/parking guy didn't speak English, I had Stan climb down out of the rear cockpit…in his space suit. Stan along with the Norwegian carried the still deployed drogue 'chute all the way to our assigned parking spot. Obviously, I taxied very slowly.

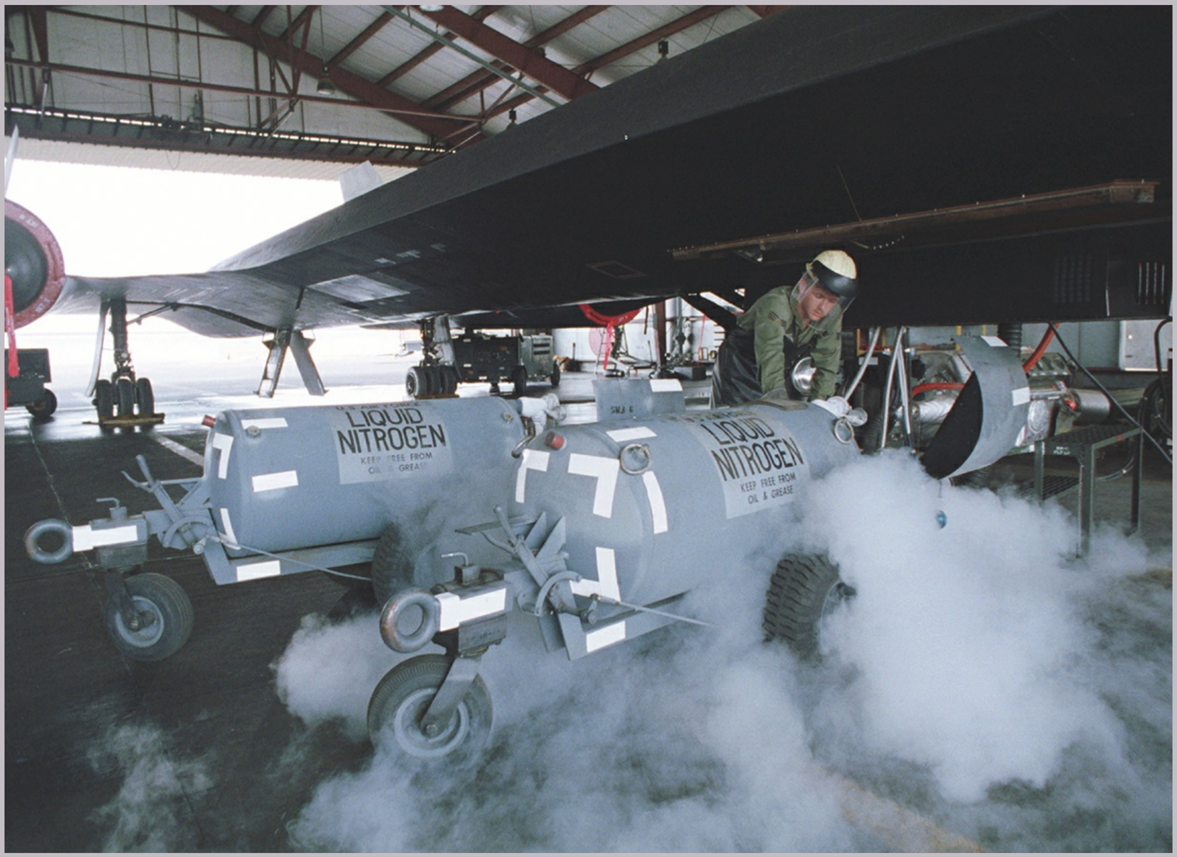
After the remaining Norwegian staff arrived, we finally ended up having some drinks while sitting on camp chairs on an Arctic Ocean gravel beach while watching the sun only get about 20° above the horizon and then begin to go up. Understandable I suppose as we were 250nm above the Arctic Circle.

POST SCRIPT

‘The fire warning turned out to be an erroneous indication. But an engine change was needed since we had exceeded the 50 minutes of allowed windmilling time.’ This would be the last occasion that a Habu diverted into Norway – time was running out for the Senior Crown programme.



CHAPTER 17: THE BARENTS


LIQUID NITROGEN
KEEP FREE FROM OIL & GREASE
LIQUID NITROGEN
KEEP FREE FROM OIL & GREASE

Readying an SR-71 for a mission began many hours before the crew arrived at the aircraft. Here a technician fills the aircraft's two liquid nitrogen dewar flasks. (Lockheed Martin)

From Chapter 14, it’s apparent how important SR-71 intelligence-gathering operations into the Barents Sea were, particularly for the US Navy. From a Soviet perspective, it’s equally apparent how important the defence of this ‘bastion’ was to Soviet naval strategy. In this chapter, a retired Soviet MiG-31 pilot, Major Mikhail Myagkiy, recalls techniques used during practice intercept attempts on Habus participating in PAROP missions to the area. Retired Lt Col Ed Yeilding and his RSO Lt Col Curt Osterheld also relive missions over this frozen hot-bed of military activity as these opposing forces squared up to one another.

In 1972, the Mikoyan OKB began working on a new design destined to replace the MiG-25 interceptors. Designed around two D-30F-6 afterburning turbofans, the aircraft would have both a lower top speed and ceiling than the MiG-25PD: however, this fourth generation interceptor, equipped with a weapons-control system based on the SBI-16 Zaslon (ASCC ‘Flash Dance’) phased-array radar, enabled its two crewmembers to intercept and destroy targets in either the front or rear hemisphere, day or night, in any weather conditions and while operating in a passive or an active jamming environment and flying at high supersonic speeds. Designated the MiG-31, the type’s final Act of Acceptance was signed in December 1981 and deliveries to PVO units began in 1982.

Like the MiG-25PD before it, the new MiG also had a full infrared search and track capability; located in a retractable pod, the STP IRST enabled the aircraft to execute attacks without recourse to its radar. Typical armament consisted of four R-33 long-range air-to-air missiles carried semi-recessed in the fuselage on AKU-410 ejector racks, or four R-60M missiles if the target was to be engaged using the IRST. Each R-33 missile weighed 1,058lb, including its 103lb HE/fragmentation warhead and had a range of 75 miles. The new Zaslon radar touted a detection range of 180km (111 miles) and a target tracking range of 120km (75 miles). The aircraft’s avionics suite also included the BAN-75 command link, the SAU-155M automatic flight control system, the APD-518 digital secure datalink system (this enabled a flight of four MiG-31s to swap data generated by their radars provided that they were within 200km (124 miles) of one another), the RK-RLDN secure datalink and the SPO-15SL Radar Homing And Warning System (RHAWS). A highly capable navigation suite enabled the MiG-31’s crew to operate confidently in the Arctic theatre of operations.

By late 1980, the flight test programme had been successfully completed, and the first MiG-31 production aircraft had been delivered to PVO units and had achieved initial operating capability. The major units to be equipped with the type were the 153rd IAP (Istrebeetel'nyy Aviapolk – fighter regiment) stationed at Morshansk, the 786th IAP at Pravdinsk, the 180th IAP at Gromovo, the 174th IAP at Monchegorsk, the 72nd IAP at Amderma and the 518th IAP at Talagi.

Russian military aviation writer Valery Romanenko has undertaken detailed research for this book, and with the help of translators James F. Gebhardt, Ilya Grinberg and Dr Heinz Berger, the fruits of an interview with Maj Mikhail Myagkiy are detailed below.

Military 1st Class Pilot Mikhail Myagkiy, Guards Major (ret.), is one of the PVO (Protivo-vozdushnoy Ororony or air defence force) pilots who executed intercepts of the SR-71 near the border of USSR in the far north. Between 1984 and 1987, he was a Mikoyan MiG-31 'Foxhound' commander with the 174th Gvardeiskaya Istrebeitel'nyi Aviatsionnyi Polk (GvIAP, Guards Fighter Aviation Regiment). During this period he conducted 14 successful SR-71 intercepts.

Myagkiy graduated from Armavir VVAKUL PVO (Higher Military Aviation Red Banner Academy of Pilots of the PVO) in 1977. He started his front-line service on the Sukhoi Su-9 'Fishpot'. He then qualified as a 1st Class Pilot on the Mikoyan-Gurevich MiG-23ML 'Flogger G', having accumulated approximately 600 hours of total flying time. At that time he held the rank of captain.

In 1983, only two regiments flew the MiG-31. The 786th IAP at Pravdinsk (near Gorkiy) was the first of these units, followed by the 174th GvIAP at Monchegorsk (near Murmansk). Before operating the MiG-31, the 174th GvIAP flew the Yakovlev Yak-28P 'Firebar'. During the transition to the MiG-31, many pilots left the unit – apparently they did not want to master the new aircraft. The majority of the remaining 174th trainees were weapon systems operators (WSOs). Therefore pilots had to be selected from other regiments because at that time only 1st Class Pilots were being selected to fly the MiG-31.

Consequently, the PVO's 14th Air Army was required to supply one pilot. At that time Captain Myagkiy was acting as a flight commander. Transfer onto the MiG-31 meant a reduction in position, since the air army commander did not release pilots from their permanent duty positions, but allowed transfer to temporary positions.

Myagkiy arrived at the 174th GvIAP in October 1983. The regiment had already been flying the MiG-31 for 18 months and had frequently flown missions against the SR-71.

After a month, Myagkiy was sent for transition training to the Tsentry Boyevoy Podgotovki, IA-PVO (TsBP IA-PVO, centre for combat readiness, PVO fighter aviation) in Savasleyka. The MiG-31 WSOs, with two of whom Myagkiy would later fly, also underwent transition training at Savasleyka.

Only conversion training onto type was taught at Savasleyka. Over the course of two months, the pilots studied two aircraft: the MiG-31 and the MiG-25PU 'Foxbat C' (the students took a separate examination on each aircraft). Initially, they flew the dual-control MiG-25PU two-seater trainers. Four flights were conducted in the MiG-25PU, and the fifth, sixth, and seventh flights in the MiG-31 (with an instructor). On the eighth MiG-31 flight, the pilots went solo (with a WSO in the back seat rather than an instructor). After this, training was solely on the MiG-31.

The flight training programme was very short. On 21 May 1984, Captain Myagkiy received his authorization for independent flights in the MiG-31, and on 21 June 1984 he received his authorization for combat readiness. This meant that he could now fly and conduct a combat patrol in daytime and in bad weather. By the end of July, the captain was carrying out combat patrols.

Mikhail Myagkiy executed his first mission against the SR-71 from a combat readiness posture on 21 August 1984. According to his recollection, the procedures for a successful intercept were crazy and completely inadequate when considered against the threat posed by the SR-71's spy flights. The speed and altitude of the American aircraft simply hypnotized everyone. Therefore, each attempted SR-71 interception was considered a top priority, not only for fighter aviation but also for the PVO's entire 10th Army. The ground vectoring station on Rybachiy Peninsula typically made the first 'sighting'. Intercepting aircraft then took off from all the airfields in the north where weather permitted. A mistake at any level – by a pilot, the ground personnel, a command post, or a ground vectoring station – brought with it the threat of a military tribunal (court martial).

Each fighter regiment executed an intercept in its own sector. For the 174th GvIAP, this was the sector of the Soviet border from Kharlovka to Cape Svyatoy Nos. For the unit's MiG-31 crews, 16 minutes elapsed from the moment the alert was sounded to the take-off command being given. Of this time, two minutes were used to put on the VKK-3 (*vysotnyy kompensiruyushchiy kostyum*, or altitude-compensating suit), two minutes to run 50 to 60m (55 to 66 yards) in the VKK and get strapped into the aircraft, and the remainder of the time to check out the systems, start engines, and taxi. After 16 minutes the fighter would be parked at the end of the runway, with its engines running, fully prepared for take-off.

When the SR-71 alert was first given, the technical personnel ran to the aircraft and initially removed its R-60 (AA-8 'Aphid') short-range missiles because they would be disabled at velocities above Mach 1.75 (the standard MiG-31 ordnance load included four R-60s and four long-range R-33s (AA-9 'Amos')). Before the aircraft was launched, its inertial navigation system (INS) had to be activated in minimum time. As soon as the green lights confirming that the INS was aligned came on (after approximately 3 minutes), the engines could be fired up.

The two crews of the ready flight prepared immediately. Everything was accomplished in a somewhat tense environment: since these aircraft were from first production series, there were occasions of system failure, particularly during the turning off of ground power. If the ground power plug was pulled out too abruptly, the INS system malfunctioned. The crew that managed to reach full readiness first was the crew that launched.

Having received permission to taxi, the aircraft took up a position at the end of the runway. Here, the crews sometimes had to 'cool their jets' for several minutes. The scheme for intercepting the SR-71 was computed down to the second, and therefore the MiGs had to launch exactly 16 minutes after the initial alert. During this period of time the ground vectoring station determined what route (out route or return route) the SR-71 was following.

Five minutes after take-off, the MiG was already at an altitude of 16000m (52,493ft). The afterburners would still be lit and the crew experiencing significant g. In addition, the MiG-31 had a disconcerting idiosyncrasy – at high supersonic speeds (above Mach 2.35), the control stick moved all the way forward, pushing up against the instrument panel. The pilot had to extend his arm fully, which was very uncomfortable and quickly caused fatigue. However, the MiG-31 was significantly more benign in its flight characteristics at supersonic speeds than the MiG-25. The great weight of the MiG-31's onboard equipment and systems had an effect on its performance compared to the

'Foxbat', but its instrumentation was significantly greater and a generation more modern.

During an SR-71 intercept, many commonly accepted practices were broken. For example, take-off was executed in a northerly direction, while normal procedure called for a take-off to the south. A number of limitations were also removed: for example, the altitude for transition to supersonic flight was established as 11,000m (36,089ft), but during SR-71 intercepts Soviet aircraft were permitted to pass through the sound barrier at 8,000m (26,247ft). Ground vectoring was usually conducted at an altitude of 16,000m (52,493ft), but during an attack the MiG-31s reached 18,500–19,500m (60,696–63,976ft) (aiming to establish the best missile launch trajectory, the MiGs gained as much altitude as they could, right up to 20,000m (65,617ft)).

Information about the Blackbird normally arrived at the command post when the spyplane was three hours out (this information coming from a radio intercept station). As the SR-71s flew out of Mildenhall, conversations between their crews and those of their supporting tankers were 'captured' during inflight refuelling, so if tankers showed up, the IA-PVO waited for the SR-71.

The standard SR-71 route was normally loop-shaped. If the spyplane appeared from the direction of Norway, it tracked toward the White Sea, farther to the north toward Novaya Zemlya, then turned around on a reverse course to the west over the Arctic Ocean. This track was called a 'straight loop'. If it initially flew from the direction of the Arctic Ocean toward Novaya Zemlya, then south toward the White Sea, then to the west along the coast of the USSR toward Norway, its track was called the 'return loop'. The tactics of the intercept were geared toward the type of loop the spyplane was flying.

The SR-71 was intercepted using only a thermal channel (infrared, IR). The massive IR emissions of its engines permitted it to be detected at a distance of 100– 120km (62–75 miles). The MiG-31's thermal detection system was called OMB (or optical multifunctional apparatus) and was mounted in the lower nose of the aircraft. The device was lowered and turned on by the WSO. The MiG's radar was not turned on. On combat alert the radar was set on a combat frequency, and in order not to expose this frequency to a 'probable enemy', the radar was not turned on. A passive system (the thermal apparatus) was adequate for a reliable intercept.

After capture of the target by the OMB, a target indicator showing the range to the target appeared on the *sistema edinoy indikatsii* (SEI, unified display system) in the pilot's head up display (HUD). A voice indicator, using a pleasant female voice (known as 'Rita' to the crews), announced 'Attack!'. The range to the target was calculated by the aircraft's BTsVM (onboard digital computer), using a triangulation method that employed other onboard sensors. This was very good, because, for example, on the MiG-25 the pilot did not receive range to target data as it was only passed from ground vectoring stations. Also, the ZDR (or zone of range of missiles, basically the engagement envelope for the missiles) was projected on the HUD.

After the 'Attack!' signal, missile preparation began. Targeting instructions were handed off to the *golovka samonavedeniya* (GSN, the missile seeker head). Four green triangles appeared on the image of the MiG in the cockpit display after the missiles had been prepared for launch.

The *bortovaya radiolokatsionnaya stantsiya* (BRLS, onboard radar) was turned on only in the event that the vectoring station issued an order to destroy the target. In this case, the WSO would turn the radar on. Information regarding the target would then be instantly transferred from the OMB to the radar. After this the pilot had only to push the firing button and the missiles would be launched.

If the SR-71 had violated Soviet airspace, a live missile launch would have been carried out. There was practically no chance that the aircraft could avoid an R-33. But in the early 1980s the Blackbirds did not violate the border, although they sometimes 'tickled' it (came right up to it). Indeed, local counter-intelligence dreamt of finding pieces of the SR-71, if not on land then in the territorial waters of the USSR.

Mikhail Myagkiy particularly remembers his eighth intercept, when he managed to gain visual contact with an SR-71, and not just in the form of a spot on a screen. As a keepsake he preserved the printout of the recording from the 'black box' through which all the intercept data was processed. Here is how he describes that flight:

> I went on combat alert on 31 January 1986 as normal. I drew my personal weapon in the morning and then headed for the on-duty crew hut.
>
> They alerted us for an SR-71 intercept at approximately 11:00. They sounded the alarm with a shrill bell and then confirmed it with a loudspeaker. To this day I have been averse even to ordinary school bells, because a bell was the first signal for a burst of adrenaline. The appearance of an SR-71 was always accompanied by nervousness. Everyone began to talk in frenzied voices, to scurry about,

and react to the situation with excessive emotion.

I ran to put on my VKK and GSh-6 [*germoshlem*, flight helmet], and over that a fur-lined flight jacket with IPS [*individualnaya podvesnaya systema*, parachute harness], and ran the 60m [55 yards] to the aircraft. I was not flying with my own WSO, but with Aleksey Parshin, our flight WSO. When I sat down and was being strapped in (it was simple and convenient to be strapped in wearing a jacket and IPS, which is why we flew in them), the readiness lamps for the INS were lit. I pressed the engine start button, reported to the command post, and immediately received the command to taxi to the runway. We sat on the runway for about five minutes; my WSO 'read the prayer' [loudly went through the pre-take-off checklist].

After the take-off order from the command post we lit the afterburners and took off. Our take-off speed was approximately 360km/h [224mph]. Not coming off afterburners, we went for altitude with a 60° right bank and turned to a course of 100°. We attained 8,000m [26,247ft] and reached the horizontal area (for acceleration) in which we passed through the sound barrier. Here vectoring station 'Gremikha' had already assumed responsibility for vectoring us. Our indicated speed at this time was 1,190km/h [739mph]. We went for altitude again, up to 16,000m [52,493ft]. At 16,000m we were flying at Mach 2.3 and made a left turn to a combat course of 360°. The WSO lowered and turned on the OMB and within five seconds had captured the target. A feminine voice in the earphones announced, 'Attack!', and a symbol was illuminated on the SEI. The SR-71 was proceeding on the 'return loop', from east to west, so we began the intercept immediately.

As usual, we executed an 'aiming run' from 16,000m, gaining altitude to 18,900m [62,008ft]. After closing to 60km [37 miles] I spotted the contrail of the SR-71 on an intersecting course. I reported the heading to my WSO over the SPU [*samoletnoye peregovornoye ustroystvo*, intercom], 'I have visual!' A contrail at 22,000–23,000m [69,000–72,000ft] is very rare, but on this day the weather was excellent and the air was transparent, and the contrail was clearly visible. I passed under the spyplane: it was 3,000–4,000m [8,843–13,123ft] above us, and even managed to make out its black silhouette. The SR-71 was flying over the ocean ever so carefully on a track 60km [37 miles] out from, and parallel to, the coast. I reported 'we're breaking off' to the command post and came off afterburners. We had been airborne for 15 minutes 40 seconds.

The Blackbird was flying its normal route, over neutral waters, and it made no sense to follow it. Therefore the vectoring station gave the command to turn onto a course for our airfield. We dropped down to 15,000m [49,21ft], transitioned to horizontal flight, and engaged a stopwatch. This was the so-called 'area for canopy cooling'. During flight at speeds in excess of Mach 2, the skin, including the canopy, heated up to 800°C. Therefore it was necessary to cool it. Failure to do so might result in cracking or catastrophic failure during subsequent altitude reduction. Our speed remained in the order of Mach 1.6.

After 30 seconds we once again began to lose altitude. We went subsonic at the normal 12,000m [39,370ft]. Dropping down to 8,000m [26,247ft], we tracked toward our airfield. After the last vector was issued the command centre handed us off to our regiment command post, which directed me to a checkpoint at an altitude of 4,100m [13,451ft]. At 32km [20 miles] out from the airfield I lowered the gear and began to descend. We conducted a straight-in landing at a speed of 310km/h [193mph]. The entire flight had lasted 50 minutes.

Majors Ed Yeilding (left) and his RSO Curt Osterheld are driven out to their waiting aircraft in the PSD van. Major Doug Soifer (centre) is one of two members of the mobile crew that would have conducted the aircraft's walk-around inspection prior to the crews' arrival at the 'barn'. Ed remarked, 'Occasionally, upon arriving at the aircraft and discovering a long, unexpected maintenance delay, it was good to have a comfortable recliner to relax in before a long mission in the heavy pressure suit'. (Ed Yeilding)

> During the 15 to 20 minutes when I was on a combat course, the second alert crew was sitting on the ground with engines running. Later they shut down their engines, but the pilot and WSO sat in their aircraft in readiness until our landing.
>
> This was the only occasion in my 14 intercepts when I saw the SR-71 with my own eyes. It was obvious that a combination of circumstances facilitated this event: good weather that was rare in the north, clear air and unusual atmospheric conditions, when the contrail was clearly visible at an altitude of 23,000m [75,459ft].

Mikhail Myagkiy retired in 1992 with the rank of guards major at the age of 36. A review of his logbook reveals the following SR-71 intercepts:

21 August 1984
14 March 1985
18 March 1985
15 April 1985
17 July 1985
19 December 1985
20 January 1986
31 January 1986
21 February 1986

28 February 1986
1 April 1986
6 October 1986
23 December 1986
8 January 1987

According to Mikhail Myagkiy's logbook, he completed two practice intercepts on an SR-71 flown by Ed Yeilding. Ed now talks about some of his experiences while flying these vital missions.

The purpose of our Barents Sea reconnaissance missions was to gather intelligence as we flew just outside the territorial waters of the Soviet Union in the area of Murmansk, Russia and toward the Kanin Peninsula of Russia. We took great pride in these reconnaissance missions and believed our missions were an important contribution to the defence posture of the free world. During the Cold War, we knew the Soviet Union was potentially hostile toward the free world, and keeping close watch of their military facilities and activities was extremely important. We were given our routes of flight and target areas for our cameras and sensors, but we were not briefed on what our intelligence agencies were interested in along this area of Russia. I imagined that imagery of submarine ports, submarines, and the nuclear missiles being loaded on their submarines would be of prime interest, since those nuclear missiles were programmed for targets in our USA and elsewhere in the free world. Also, the Blackbird recorded Soviet electromagnetic transmissions of various types along our track. Our SR-71 missions were of vital importance, and we took great care in performing our missions flawlessly and with good judgment in handling various systems failures that could occur.

Our Barents Sea missions were conducted from our Detachment 4 at RAF Mildenhall, England. We Habus thoroughly enjoyed our periodic six-week assignments to Mildenhall, from where we flew missions not only to the Barents but to other areas as well. The flying was interesting and satisfying, and the British were friendly, supportive, and seemed to appreciate having us there. In our spare time, we greatly enjoyed seeing nearby sights and experiencing life in Great Britain.

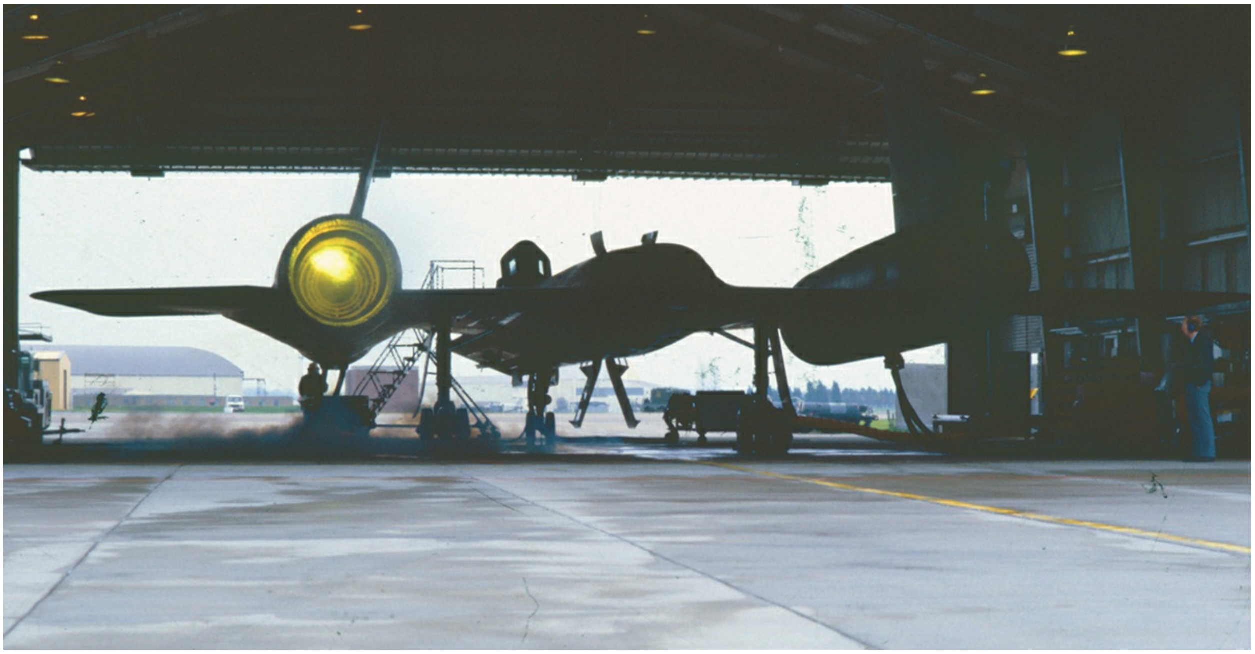
For a typical Barents Sea mission, we departed Mildenhall half loaded with fuel for take-off safety, and within minutes we joined a KC-135Q, also from Beale AFB. The KC-135Qs always did an excellent job. Our rendezvous were at 25,000ft. Our UHF radios were encrypted with the classified code of the day and gave us automatic range and bearing for the join up without voice transmissions. Once joined and taking fuel, we were able to talk to the tanker crew through our interphone.

Ed and Curt work through the challenge and response checklist prior to engine start. (Ed Yeilding)

Air refuelling was challenging, especially in heavy turbulence, and we took pride in doing it well. Approaching full tanks, we were always 'behind the power curve' at that weight and slow speed, so it was necessary to finish the refuelling with asymmetric thrust, one engine in minimum afterburner and staying in position with throttle movements of the other engine at less than military power. Approaching full, the RSO skilfully had the tanker adjust the rate of transfer so that we were totally full with an automatic pressure disconnect at exactly our planned start climb and acceleration point.

With full tanks, our flight manual recommended 'the climb-and-descent procedure' as the most fuel-efficient way to intercept the supersonic climb schedule. Most crews simply called it the 'dipsy'. Simply stated, we climbed at Mach 0.9 to 33,000ft and gently nosed over with maximum thrust. In the descent, the acceleration hesitated approaching Mach 1, then suddenly increased beyond Mach 1, as the altimeter momentarily fluctuated about 1500ft as the shock wave passed over the static ports. Because the Blackbird was designed for supersonic flight, there was no vibration or other sensation of becoming supersonic. Even though supersonic, we could still hear the engines because engine sound was transmitted through the frame to the cockpit and not excessively loud. Stopping the descent near 30,000ft, I liked to glance through the periscope at our 'dipsy' contrail which looked like a roller coaster.

We climbed north and accelerated to Mach 3.0 and 71,000ft. Off the northwest coast of Norway, we descended to meet our second set of KC-135Q tankers in a refuelling track unofficially called 'Viking North'. After refuelling, we again climbed north, paralleling the coast of Norway, rounded the northern tip of Norway near 72° north latitude, well above the Arctic Circle, and soon again reached Mach 3.0 and 71,000ft, now heading east into the Barents Sea.



Once the compressed air system began to spool the engine up, the pilot moved the applicable throttle forward to the IDLE position, checked for immediate fuel-flow increase on the fuel-flow gauge: ignition occurred within 20 seconds as the TEB lit the fuel – as seen on the ground from the emerald-green flash. (Paul F. Crickmore)

Lined up with wheels chocked and brakes tightly on, each engine had to undergo an EGT check, one engine at a time, before take-off. (Curt Osterheld)

We flew a slow cruise climb of about 130ft per minute because we became more fuel efficient at higher altitudes as aircraft weight became lighter with decreasing fuel. The Blackbird was designed for best fuel economy at Mach 3.2, but our Barents missions were planned at Mach 3.0 and 32° of bank to aid in handling unstarts, manual inlet situations, and higher than forecast temperatures if any of those happened.

Mach 3.0 is about 1,980mph (1,721kt) at -56.5°C, the standard temperature of the stratospheric air in which the Blackbird flew. (The speed of sound in air is only proportional to the square root of air temperature in Kelvin and surprisingly does not vary with air pressure or density.) At 1,980 mph, 32° of bank gives a turn radius of 80.8 miles (70.2nm), so that a 90° turn took about 3.8 minutes to complete.

We always had the autopilot engaged in the reconnaissance area because it held a steadier platform for our cameras and sensors. The autopilot held constant pitch attitude, so I made climb rate and altitude adjustments with the autopilot pitch wheel on the right console. I maintained precise airspeed with smooth throttle inputs. We did not have auto throttles keeping exact speed, as many modern aircraft have today.

The autopilot flew the planned track with imperceptible small roll inputs, guided by the astro-inertial navigation system, ANS. The track and sensor action points were loaded as a spool of magnetic tape into the Blackbird before flight, and the autopilot followed the magnetic tape track amazingly well. During rare failures of the autopilot, I could precisely fly the track by keeping the course deviation indicator (CDI) centred with gentle roll inputs with the flight control stick. In those years before GPS navigation, I was amazed that the Blackbird had a small telescope, under glass behind the RSO, automatically tracking stars and updating the ANS inertial position, because our flights were often outside the range of reliable ground navigation transmitters.

In full afterburner and generating 68,000lb of thrust, acceleration down the runway was fast and the Habu was usually airborne at 210 knots, 4,000ft down the runway on a 15°C day. (Paul F. Crickmore)

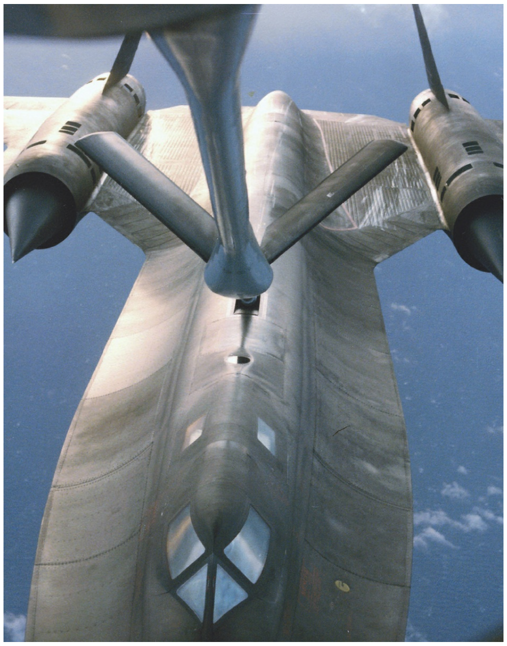
Barents Sea missions were especially interesting because the Barents Sea is above the Arctic Circle. I will never forget my very first entry into the Barents Sea area. RSO Steve Lee and I had completed our very challenging but very satisfying SR-71 training in the summer of 1984, a dream come true for both of us! That fall, we had our first operational experience at Okinawa, and now on 10 Dec 1984, we were on our very first Mildenhall mission, a mission to the Barents Sea. There we were, just starting our cruise at Mach 3.0, 71,000ft and had just rounded the northern tip of Norway near 72° north latitude, flying toward the east. I was full of anticipation, as we were just minutes from beginning our very first reconnaissance pass along Russia's northern coast.

In the eerie December twilight, I happened to look about 90° to my left, and was very surprised to see a nearly full moon had risen and was sitting there just above the horizon! Having always lived at low latitudes, I knew the moon always rose approximately in the east. Suddenly, I had deep concern as I thought, 'Is east over there? If so, we're flying south, straight into Russia!' My magnetic compass was within 15° of my heading indicator, which I was very glad to see. Just to be sure, I asked Steve if he still had a 'star light'. He did, which meant our ANS was happily tracking stars and navigating accurately. I immediately realized the moon was in an unusual spot because of our high latitude, and I then resumed total concentration on flying the Blackbird. Our first mission went very well. Only after our mission did I take time to reason that in December, the earth's northern axis is tilted away from the sun and tilted toward an almost full moon. The earth's tilt, combined with our high altitude at that high latitude, had allowed me to look over the top of earth and see the moon on the other side. Seeing the newly risen moon sitting just above the northern horizon near the North Pole had caught me by surprise and caused me an anxious moment during my very first entry to the Barents Sea.

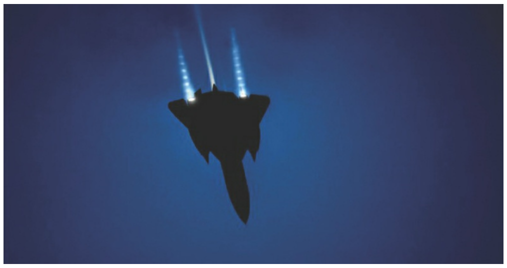
On winter days in the Arctic, the day/night line, called the terminator, runs almost east-west at noontime. Even though the Barents Sea is entirely above the Arctic Circle, we could often see the sun, low on the horizon, even in late December, due to our high altitude. The Blackbird mission track might cross the terminator several times, causing the crew to see a sunset or sunrise each time. On those missions, our primary sensor was usually the Advanced Synthetic Aperture Radar System, ASARS, which could obtain imagery day or night. I once had a mission track in late December that surprisingly crossed the terminator six times, so in the space of just an hour, we'd seen three sunsets and three sunrises!

With the Soviet Union just to the south, flying at the far east end of the Barents Sea was foreboding, especially daunting in the dim twilight of winter, with over 600 miles of sea ice and icebergs between us and our friendly tankers waiting at 'Viking South', off the northwest coast of Norway. If something happened to our Blackbird that required ejection, I was not confident that we could survive long enough with our small, one-man life rafts to be found and rescued from the hostile, windy, frigid Barents Sea. Thanks to outstanding Blackbird maintenance, excellent training, leadership, and good fortune, no Blackbird was ever lost in the Barents Sea, nor was any Blackbird ever lost during Mildenhall Det 4 operations.

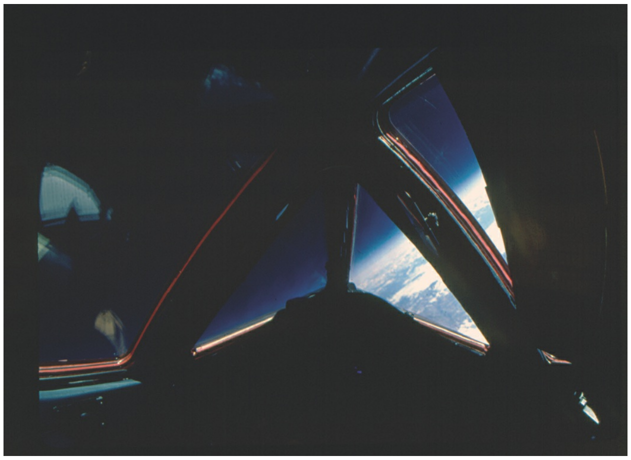
After about three weeks of Mildenhall flight experience, possibly 31 Dec 1984, RSO Steve Lee and I had a malfunction that caused us some concern. There we were, Mach 3.0, about a quarter of the way through our Barents Sea reconnaissance track, and our cockpits started to overheat. I usually kept our cockpits at about 68°. I turned the cockpit temperature control full cold and checked my pressure suit heat off. Cockpit temperature continued climbing through 80°. I called for the cockpit overtemp checklist, which we worked our way through slowly while Steve continued his reconnaissance duties. The checklist calls for a number of switch actions with several waits to see effectiveness. We also had several circuit breaker pulls and resets that we had pencilled in during training. Now, we were at the far east and most foreboding end of our Barents Sea track and the temperature was rising through 110°.



Shortly after take-off, the SR-71 was fully fuelled with JP-7 in order to purge the tanks of any air. As fuel burned off, the void was filled with gaseous nitrogen. Here ‘979 gets a top-off in the Goose Green refuelling track off the coast of Scotland. (Curt Osterheld)



With full tanks, Ed lit both burners, accelerated and climbed away from the tanker to undertake a ‘dipsy’ manoeuvre before beginning the climb to 71,000ft and acceleration to Mach 3. (BC Thomas)



The forward view from the pilot's cockpit of an SR-71 with the sun-shade on the right. At 80,000ft, the horizon could be seen 350 miles away. (B. C. Thomas)

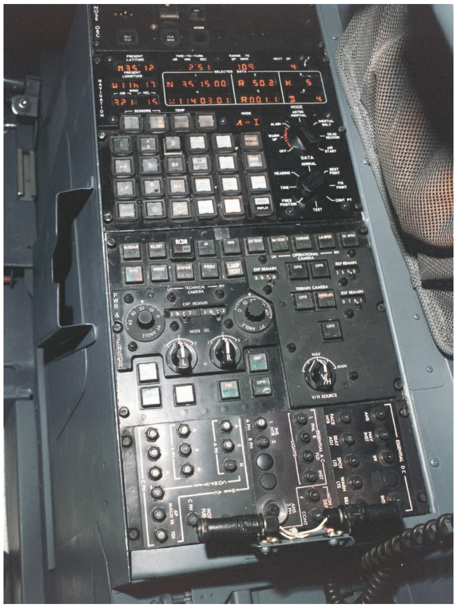
Curt takes a selfie whilist at 'the office'… over 70,000ft high. (Curt Osterheld)

I was pretty concerned because I did not know how much hotter the cockpit would get. I knew air friction caused the aircraft skin to be around 550°F. Touching the cockpit windows with our pressure suit gloves was like touching an oven window. I thought how ironic it would be to die of heat stroke when ice was all I could see for hundreds of miles. I knew that if we started to get dangerously hot, I could turn northwest, getting more distance from Russia, while descending. At 25,000ft, Steve could then accomplish the last step in the checklist, 'Cockpit air – OFF (forward)', which would stop the inflow of hot air, but would depressurize the cockpit, which is why we would not do that step at cruise altitude. I knew it would take about 10 minutes to descend, so I would need to make that decision well before becoming dangerously hot. Fortunately, the temperature stabilized at 122°. We were uncomfortable, but the warm, very dry air circulating in our suits kept us functional. Steve told me his grease pencil, which he used for notes, had melted. When I opened my checklist, the plastic pages curled up. We were able to stay on track, though, and got all our pictures.

Steve had done an outstanding job, working in the heat, accomplishing all his reconnaissance duties while alternating reading overtemp checklist items to me. I remember, too, air refuelling in 'Viking South' on the way home. The stick was too hot to hold firmly, as I always did during refuelling. That time I had to use fingertip control while alternating fingers. With the cockpit air off, the temperature dropped to 85°, but after refuelling, we turned the cockpit air on again to pressurize the cockpit for a climb and cruise home at the lower altitude of Mach 2.4 in case we needed to descend quickly. Arriving at Mildenhall we were a couple of hot Habus, happy to be home. Thus ended an uncomfortable, but successful, mission over the frigid Barents Sea!

In the springtime, as the Barents Sea's ice started to break apart, I could look down and see where the big pieces had fit: like seeing a puzzle which had some pieces dislodged, you could see where the pieces belonged. In the Arctic at cruise altitude, temperature deviations were much larger than at mid latitudes. I remember seeing plus 15°C to minus 20°C from standard, causing significant variation in fuel burn rates. Colder temps enabled the Blackbird to climb faster and burn less fuel during cruise. I almost always flew max range altitude, but one very cold day in the Barents after exiting the reconnaissance area with RSO Steve Lee, I climbed our Blackbird up to the flight manual limit, 85,000ft, just so we could say we had been there. Higher altitude causes a decrease in knots equivalent airspeed [KEAS], and arriving at 85,000ft and Mach 3.2 we were also at the lower supersonic limit of 310 KEAS. Below that could cause an engine flame-out. After about a minute at 85,000ft, where we could see the horizon 357 miles away, we descended to meet our tankers at 'Viking South' off the northwest coast of Norway. That day, at the west end of the Barents, at 85,000ft, is the highest I have ever been, thanks to the amazing SR-71 Blackbird!

The colder than standard air of the Barents often caused the Blackbird to leave long contrails during cruise. Contrails, short for 'condensation trails', are caused by water in jet engine exhaust condensing and turning rapidly to ice crystals. Whether a jet will leave a long contrail is a function of air temperature, humidity, and air pressure or altitude. Jet contrails at lower latitudes are common between 25,000 and 40,000ft, but extremely rare at Blackbird cruise altitudes. However, in the Arctic region the Blackbird often left long, visible contrails, especially in winter. In addition to visible contrails, we were told that Soviet radars could sometimes detect us intermittently as we flew along their borders, even though the Blackbird was designed with some early stealth features.



The RSO's right console contains controls for the OBC. Next is the ANS display followed by controls for the ground mapping radar and technical camera. The last area of the panel contains various circuit breakers. (Curt Osterheld)

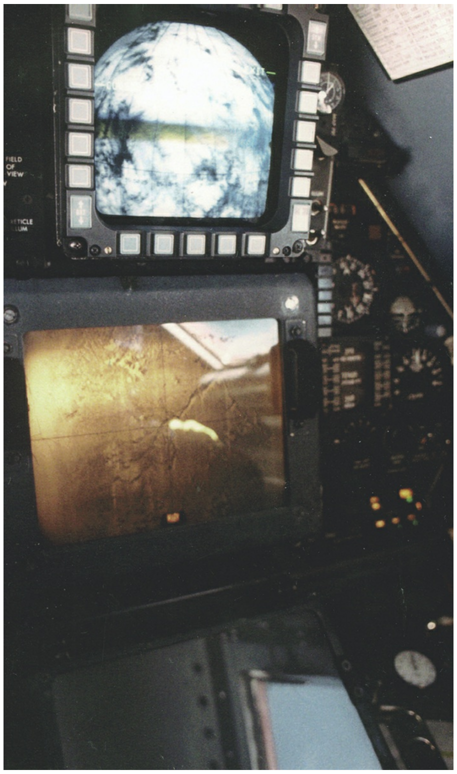
Another of my Barents missions was especially memorable because we had an encounter with a Soviet MiG-31. Because most details of Blackbird flights were classified at that time, I made no notes about the encounter, so I cannot verify the date. I am certain that RSO Curt Osterheld was with me at the time. Curt and I had only two tours together at Mildenhall, so the encounter was between 25 Aug 1986 and 8 Oct 1986, or between 14 Apr 1987 and 7 May 1987. (I don't remember why that second tour was only three weeks.) I think the encounter might have been the last flight of our first tour. My flight records show we had a 4.1-hour mission with Blackbird tail '980 on 6 Oct 1986.

On that memorable MiG-31 encounter mission, I was glad to be flying with Curt, an outstanding RSO admired by all, and, by the way, one of the most popular Habus. (As of this time of writing, he was our excellent master of ceremonies at our last three large Blackbird reunions.) About 30 years ago, there we were, 71,000ft, starting our Mach 3.0 reconnaissance track, heading east just outside the territorial waters of Russia's Murmansk area coastline. I knew Curt was very busy in the rear cockpit with his many duties monitoring and managing cameras, sensors, and navigation. I kept a constant crosscheck of the many indicators and controls in the front cockpit, watching carefully for potential system failures, and maintaining stable airspeed and the most efficient altitude for our weight.

After Curt and I completed our first pass flying southeast parallel to the Russian border, gathering imagery and electronic intelligence, our mission track turned us left about 90° and northwards, directly away from Russia over the Barents Sea. After the turn and perhaps another minute in that northerly direction, we turned 180°, and flew directly towards and perpendicular to the Russian coast.

Although the MiG-31 cannot match the MiG-25 in terms of outright speed, the 'Foxhound' is a much more capable interceptor. This three-ship formation of MiG-31BMs consists of 'Red' 37, 34 and 38. (Yefim Gordon]

Our altitude then was probably about 75,000ft. At that altitude, we could see the horizon 335 miles away and see the slight, but noticeable, curvature of the earth. The view was grand. Ahead were miles of Barents Sea and snow-covered Russia beyond. In the distance far ahead, at perhaps 100 miles, I could see a long, bright white Russian contrail flying directly toward us, but at a much lower altitude. I knew it must be a Soviet fighter, probably a MiG-31, then the newest Soviet supersonic interceptor. I raised my periscope and saw that we too were leaving a long contrail. I knew the fighter could see our contrail as easily as I could see his. Since we were flying a routine reconnaissance track that the Soviets had seen many times, I knew the fighter knew exactly where we would start our 90° right turn to parallel the coast in a westerly direction.



The RSO's view-sight display can be seen at the top of this photograph. The Advanced Synthetic Aperture Radar System I (ASARS I) display is located immediately below. The ASARS I system generated high-resolution radar imagery regardless of day, night or cloud conditions. (Curt Osterheld)

I imagined the Soviet fighter pilot was much like me, with a love of aviation and trying hard to be one of the very best. I also assumed he had orders to fire his missiles if I was late with my turn and slipped over Soviet territorial waters to within 12nm of Soviet land, and I assumed the pilot would like nothing better than an opportunity to fire his missiles at an SR-71 Blackbird. Just three years prior, on 1 September 1983, a Soviet fighter shot down a Korean Air Lines 747 that accidentally crossed into Russian airspace north of Japan, killing all 269 aboard. Certainly, the SR-71 Blackbird would be a prized target.

I believed the Soviet fighter would not fire his missiles as long as we stayed on our usual track, but I also knew he or his ground controllers could mistake our position as being closer than we actually were. In the 1980s, we were not too concerned about missiles as long as we maintained our high altitude and high speed. (For an excellent justification for our 1980s confidence concerning missiles, see Col Rich Graham's book, *Flying the SR-71 Blackbird*.) From my previous years of flying intercepts in the F-4 fighter, I knew the newer MiG-31 would still have difficulty manoeuvring to the required launch envelope even if he knew our exact flight path. Also, in the high altitude thin air, we believed that missile manoeuvrability, range, and proximity fuses were not adequate to bring down the Mach 3 Blackbird. For radar-guided missiles, our low radar reflectivity further decreased missile 'probability of kill', and we had a jamming capability for further assurance. I knew our contrail could help him visually put his piper on us for a heat-seeking missile 'lock-on'. We had no defences like flares against heat-seeking missiles, but again, we believed that missile 'probability of kill' was very low due to our high speed and altitude. I was determined to fly the track as planned and get the pictures.

Here an SR-71 is seen with a contrail at about 30,000ft and in a descent (no afterburners). It wasn't unusual for the Habu to contrail at 70,000ft+ with temperatures much colder than standard in the Barents area. (Ed Yeilding).

While stationed with the 174th GvIAP at Monchegorsk, Military 1st Class Pilot Major Mikhail Myagkiy (unknowingly at the time) completed 14 practice intercepts (PIs) against the SR-71. Two of these were against SR-71 980 flown by Major Ed Yeilding on 31 January and again on 6 October 1986. (Mikhail Myagkiy via Paul Crickmore)

Flying straight toward each other in our supersonic jets, I was reminded of two gallant medieval knights galloping full speed toward each other, only I did not have a weapon. For survival, Curt and I depended on accurate navigation to keep us just outside Soviet territorial waters to prevent a launch, and we depended on our superior speed and altitude in case missiles were launched.

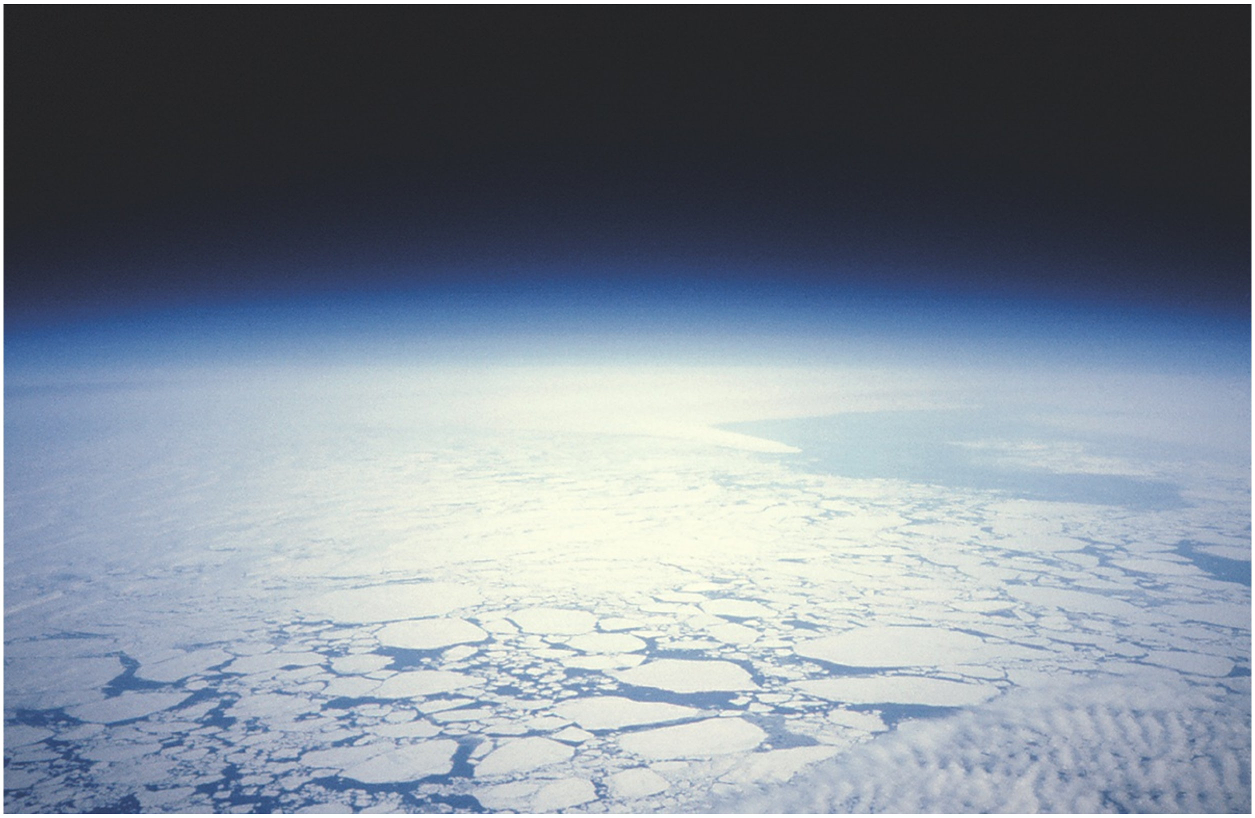
The fighter's contrail was holding constant altitude and was heading straight toward us, but far below, perhaps altitude 40,000ft I guessed. I imagined he might be accelerating for a possible steep climb toward our altitude. I watched our distance indicator count down to our turn point, decreasing a mile every two seconds. As always, I was prepared, if necessary, to start the turn manually with the autopilot roll wheel or with the flight control stick, but at our turn point, the autopilot automatically initiated our 90° turn to the right.

Our 90° turn toward the west was programmed for 32° of bank. In the turn, I kept close watch on my instrument panel as always, ready to handle any malfunction. During my instrument crosscheck, I turned my head frequently to watch the fighter's contrail and saw that he was in a very steep climbing turn toward us. Perhaps a minute into my turn, while turning my pressure suit helmet with my hands so that I could see behind, I saw the grey metal of the fighter, low at my left 7:30 position, at the top of his steeply climbing contrail. We were still in our right 32° banked turn, but I could see him, barely larger than a dot. I could not discern any identifying features like twin tails or distinctive shape. From my F-4 experience with intercepts and visual acuity, my best guess is that 8 miles was his closest approach. He appeared to run out of airspeed at the top of his contrail, at maybe 65,000ft or about 10,000ft below us. I saw his nose drop below the horizon and fall away. Curt and I stayed on course and got the pictures.

During my three years of flying overseas reconnaissance missions, I frequently saw contrails far below of potentially hostile fighters, but that day, above the Arctic Circle over the Barents Sea, was the only time I saw a Soviet fighter get close enough that I could actually see metal, though barely larger than a dot and only because our routine track was predictable. Back at Mildenhall, during our debriefing, our intelligence officer told us, with near certainty, that the interceptor was a MiG-31, the premier Soviet supersonic interceptor at that time.

Flying the Blackbird was exciting, and the friendships among crewmembers and Blackbird community were great. Best of all, during those Cold War years, we all felt we were performing a vital mission for our country and for the cause of freedom worldwide.

In the back seat with Ed on the 6 October 1986 intercept was Maj Curt Osterheld, who provides an insight into what it was like as an RSO.



The Barents Sea seen by Ed and Curt from 70,000ft+ was both outstandingly beautiful and foreboding. Note the slight curvature of the earth and dark sky overhead caused by cruising above 97 per cent of the air's molecules. (Ed Yeilding)

MiG-31 ‘Blue 36’ is seen armed with its most common weapons complement of four R-33 long-range AAMs under its fuselage and four R-60M short-range AAMs, mounted in pairs on twin APU-60-2 racks under the wings. (Yefim Gordon)

My purpose here is to provide some observations about the SR-71 in general, as noted from my office that was 5ft behind Ed’s.

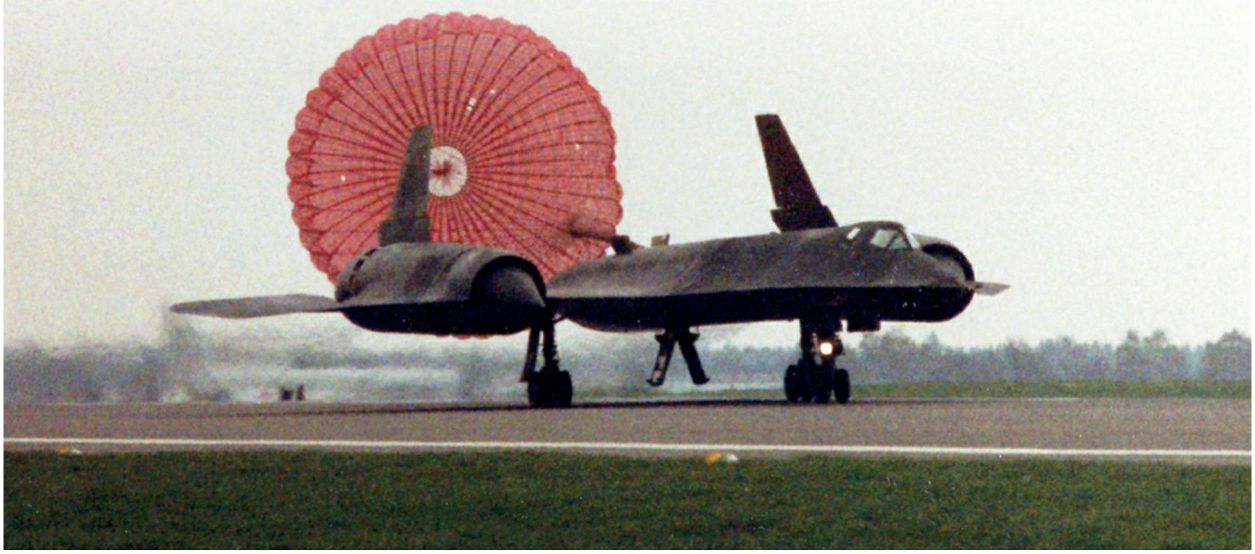
Aeronautical engineers talk about the Blackbird as a ‘system of systems’. I think of the aircraft as a series of miraculous technological innovations all flying in very close formation.

Much has been written about the engine/inlet combination that made it possible to convert a turbojet-powered vehicle into a quasi ram-jet that made prolonged Mach 3 cruising flight possible. But from my perspective, the astro-inertial navigation system (ANS) was equally astounding. To think that this system could guide the SR’s flight path anywhere in the world without the assistance of a single terrestrial-based navigation aid was amazing. And please don’t forget this was before the advent of GPS by many years. And while the ANS kept you on course (on the ‘black line’, if you will), it also provided the precise pointing data for the sensors. All this while you were moving at the muzzle velocity of a 30.06 rifle bullet.

Depending upon the aircraft's weight, outside air temperature and pressure, the basic final approach speed of an SR-71 was 175 kt (201mph). (Paul F. Crickmore)

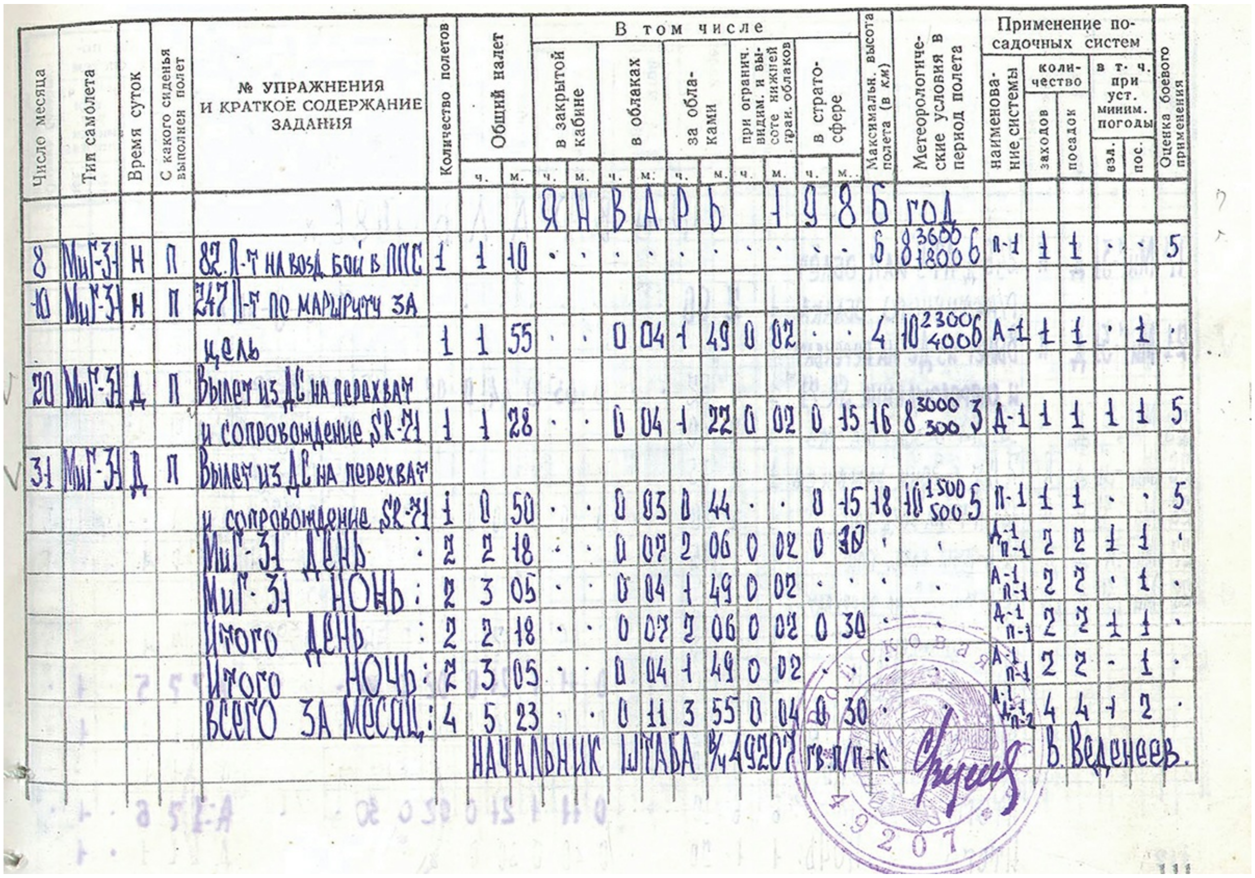
In training, RSOs were taught to take a 'trust but verify' approach with the ANS. The simulator could provide great embarrassment if one became complacent about turn points and course maintenance. Getting lost at Mach 3 is difficult to recover from ... and/or explain to your instructor. But in 631 flying hours and 98 operational sorties, I never had a glitch with the real, live ANS.

One reason training and mission preparation was so critical is that each SR-71 had its own idiosyncrasies. Many of these were minor … a difference in fuel flow here, a slightly higher hydraulic pressure there, and some leaked much more on the ground than others. (NB Leaking fuel seems to be a favourite topic when discussing the SR at forums or in museums. One of the differences in 'leak rate' was the integrity of the sealant inside the fuel tanks. Recall that the SR did not have internal fuel bladders. The heating and cooling cycles of supersonic flight took a toll on this material. Aircraft that had just returned from Periodic Depot Maintenance (PDM) where this sealant was reapplied leaked far less than jets that had been in service for a while.)



As soon as the SR-71's main gear touched down, the pilot pulled the T-handle that deployed the 40ft drag 'chute. (Curt Osterheld)

SR-71A '972 taxiis back to one of the two purpose-built hangars at RAF Mildenhall. (Paul F. Crickmore)



Число месяца	Тип самолета	Время суток	С какого сиденья выполнен полет	№ УПРАЖНЕНИЯ И КРАТКОЕ СОДЕРЖАНИЕ ЗАДАНИЯ	Количество полетов	Общий налет ч.	Общий налет м.	В том числе: в закрытой кабине ч.	в закрытой кабине м.	в облаках ч.	в облаках м.	за облаками ч.	за облаками м.	при огранич. видим. и высоте нижней гран. облаков ч.	при огранич. видим. и высоте нижней гран. облаков м.	в стратосфере ч.	в стратосфере м.	Максимальн. высота полета (в км)	Метеорологические условия в период полета	Применение посадочных систем: наименование системы	количество заходов	количество посадок	в т. ч. при уст. миним. погоды взл.	в т. ч. при уст. миним. погоды пос.	Оценка боевого применения
								Я	Н	В	А	Р	Ь		1	9	8	6	год						
8	МиГ-31	Н	П	82. П-т на возд. бой в ППС	1	1	10	·	·	·	·	·	·	·	·	·	·	6	8 3600/1800 6	П-1	1	1	·	·	5
10	МиГ-31	Н	П	247 П-т по маршруту за цель	1	1	55	·	·	0	04	1	49	0	02	·	·	4	10 2300/400 6	А-1	1	1	·	1	·
20	МиГ-31	Д	П	Вылет из ДС на перехват и сопровождение SR-71	1	1	28	·	·	0	04	1	22	0	02	0	15	16	8 3000/300 3	Д-1	1	1	1	1	5
31	МиГ-31	Д	П	Вылет из ДС на перехват и сопровождение SR-71	1	0	50	·	·	0	03	0	44	·	·	0	15	18	10 1500/500 5	П-1	1	1	·	·	5
				МиГ-31 ДЕНЬ:	2	2	18	·	·	0	07	2	06	0	02	0	30	·	·	А-1 П-1	2	2	1	1	·
				МиГ-31 " НОЧЬ:	2	3	05	·	·	0	04	1	49	0	02	·	·	·	·	А-1 П-1	2	2	·	1	·
				Итого ДЕНЬ:	2	2	18	·	·	0	07	2	06	0	02	0	30	·	·	Д-1 П-1	2	2	1	1	·
				Итого " НОЧЬ:	2	3	05	·	·	0	04	1	49	0	02	·	·	·	·	А-1 П-1	2	2	-	1	·
				ВСЕГО ЗА МЕСЯЦ:	4	5	23	·	·	0	11	3	55	0	04	0	30	·	·	А-1 Д-1 П-2	4	4	1	2	·

НАЧАЛЬНИК ШТАБА в/ч 49207 гв. п/п-к В. Веденеев.

49207

This page of Mikhail's log records two SR-71 PIs, on 20 and 31 January 1986. The second was flown by Majs Ed Yeilding and his RSO at that time Steve Lee. (Mikhail Myagkiy via Paul Crickmore)

The biggest distinction between aircraft was their performance at Mach 3 cruise. Some were incredibly smooth ('971 was a Cadillac). Some acted like they did not want to go Mach 3 (I'm talking about you, '974!) Keeping the CG within the proper range was critical to safe and efficient flight. Some aircraft required a great deal of forward fuel transfer juggling. Others required very little. But the remarkable fact was that all these anomalies could be programmed into our simulator to keep the crews sharp.

The defensive systems (DEF Systems) of the SR-71 were largely automatic. You had an idea who/what was looking at you, but it was not as specific as, say, the ALR-46A, which we had in the RF-4C 'back in the day'. I confess 30 years has taken away any specific memories of DEF operations other than it was a 'set it and forget it' type proposition.

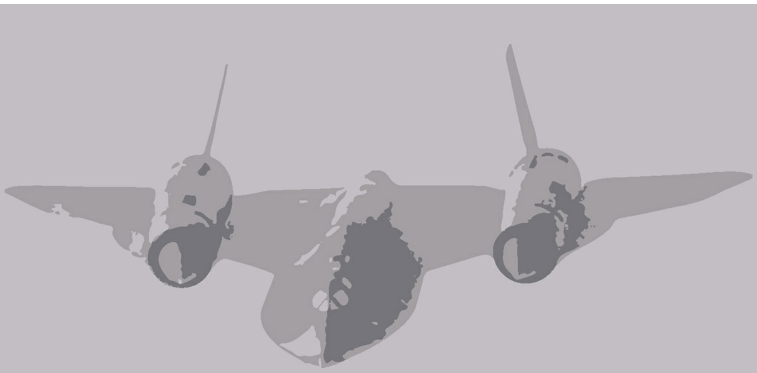
Ed's description of operations in the Barents Sea is perfect. We knew that the mission was strategically critical in keeping an eye on the Soviet ballistic missile submarine fleet. But we were also aware that if something went wrong with the airplane, the crew did not have many options. Given that we were operating under the rules of the Peacetime Aerial Reconnaissance Programme (PARPRO), our path was predictable and the Soviets used us for 'training' … both for surface to air missiles and fighter intercepts. I do have a very clear memory of turning westbound away from Novaya Zemlya (a.k.a. Banana Island). Looking out the right window and with the help of the mirrors, I could see we were pulling a fat contrail at 75,000ft. Looking down I could see a pair of circular contrails, which, I assumed, were Soviet fighters setting up for a 'practice' intercept. We believed that the only chance an interceptor (MiG-31) would have at a decent shot was a 'beak-to-beak' pass. I believed, like Ed, the velocity of closure and geometry of the required manoeuvre gave a very low PK (Probability of Kill) to this shot.

After we exited the 'sensitive area' it was time to start planning our descent for a refuelling off the coast of Norway. And here it is appropriate to salute our tanker brothers and sisters … none of this would have been possible without their teamwork.

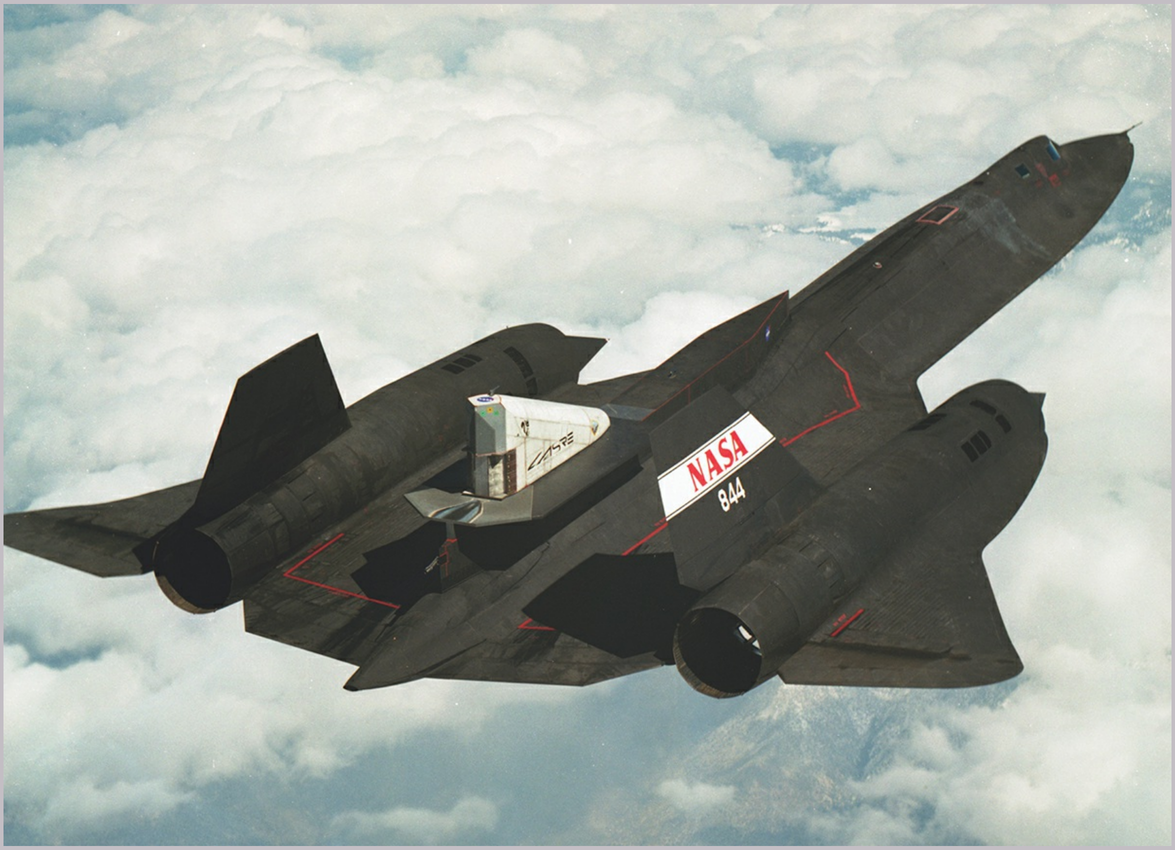
Like Ed, I felt extremely honoured to serve our nation with so many outstanding Americans in the Blackbird programme.

If there is one regret I have about the SR-71 programme, it's that I did not thank our maintenance folks often enough. The Blackbird was a very labour-intensive airplane, and these dedicated men and women kept it flying in all kinds of weather, all over the world. They are the real heroes.

Another mission successfully complete, Curt (left) and Ed's next stop is a post-flight briefing. They report a great feeling of satisfaction after each mission, having just flown the world's fastest jet and contributed to the defence of their country and that of the west. (USAF)



CHAPTER 18:
NASA



Among the final NASA SR-71 flights were those associated with the LASRE programme. In the event, the LASRE aerospike was never fired in flight, since insurmountable problems with fuel leaks made this too hazardous. (NASA)

In 1967, the Ames Research Center of NASA negotiated with the US Air Force for access to early A-12 wind tunnel data. These tests had been conducted at Ames sometime earlier in conditions of utmost secrecy. The Air Force decided to release the information and in return NASA provided a small team of highly skilled engineers to work on the SR-71 flight test programme. In the summer of 1967, a team from the Flight Research Center (FRC) under the leadership of Gene Matranga was engaged on various stability and control aspects of the SR-71 flight research effort at Edwards. This work helped to speed the SR-71 into the inventory and led to the establishment of a close working relationship between the Air Force and the NASA team.

The Office of Advanced Research Technology viewed the F-12 not only as a superb technical achievement, but also as a potential source of flight data applicable to future commercial supersonic transports (SSTs). NASA therefore requested an instrumented SR-71 to conduct research, or to have their instrumentation packages installed on other USAF Lockheed research and development aircraft. Unable to accommodate either request, the Air Force offered NASA the two remaining YF-12s in storage at Edwards. With funds available from the cancelled X-15 and XB-70 programs, NASA accepted the offer and agreed to pay the operational expenses. Aerospace Defense Command (ADC) supplied maintenance and logistic support, and on 5 June 1969 a memorandum of understanding (MoU) was signed between the two parties.

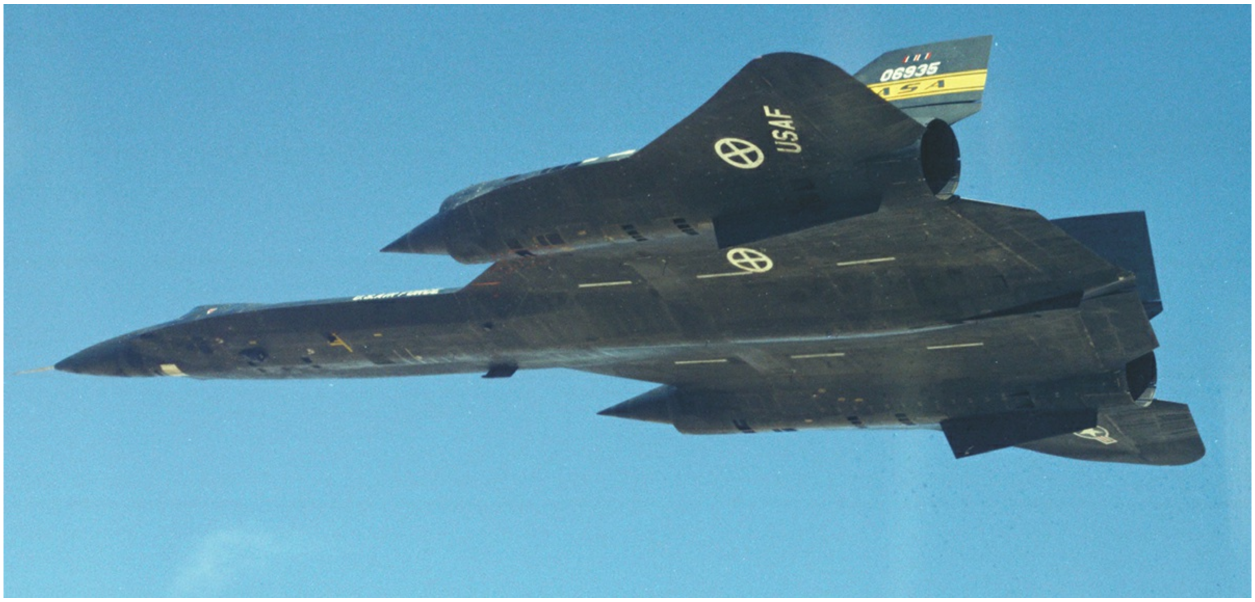
Utilization of these high-speed research platforms was frequent, since NASA engineers at Langley were interested in using them for aerodynamic experiments and testing advanced structures. Lewis Research Establishment wanted to study propulsion, while Ames concentrated on inlet aerodynamics and correlating wind-tunnel data with actual flight data; additionally the aircraft could be used to support various specialized experimentation packages. Taken together, it was hoped that many problems 'worked around' during earlier test programmes could be designed out of any future commercial venture, thus avoiding expensive mistakes.

Three months' work was needed to ready the two YF-12s (60-6935 and 60-6936) for flight. During this time instrumentation readily available to study aerodynamic loads and structural effects was installed by FRC technicians aboard 60-6935. Strain gauges were installed within the wing and fuselage and thermocouples mounted on the left side of the aircraft to measure high-Mach temperature readings.

The first NASA flight test team standing in front of YF-12A 60-6935 are (left to right) Ray Young, Fitzhugh Fulton, Donald Mallick and Victor Horton. (NASA)

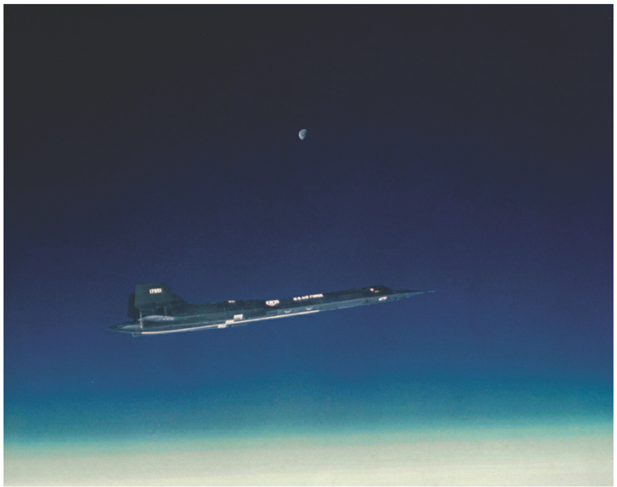
On 11 December 1969, the joint NASA US Air Force flight test programme was launched when for the first time in three years a YF-12 climbed away from Edwards. Phase one of the programme was controlled by the Air Force and consisted of developing procedures for establishing limitations for command and control and for working out possible bomber penetration tactics against an interceptor with the YF-12's capabilities. However, this phase of the programme was terminated during the closing stages of the 63rd flight of 60-6936 when it was lost on 24 June 1971. A fuel line fatigue fracture triggered a fire that engulfed the entire aircraft while it was on base leg into Edwards. Fortunately both Lt Col Ronald J. Layton and systems operator Maj William A. Curtis ejected safely before 6936 crashed into the middle of the dry lakebed and was totally destroyed.

In contrast, the NASA programme was a long-running success. YF-12 60-6935 became a real workhorse for NASA. A 'flight loads' research programme involved installing a camera within the fuselage to photograph the structure during moderate G manoeuvres. It revealed that under certain conditions the aft end of the fuselage deflected some 15cm from the centreline.



An early NASA flight test experiment conducted on YF-12A 60-6935 had a rear-facing camera installed on the lower fuselage adjacent to the nose landing gear to measure structural deflection of the fuselage during flight. The cross in a circle markings aided accurate camera focusing for chase aircraft and ground-based cameras. (NASA via Tony Landis)

After the 22nd flight of 6935 on 16 June 1970, the airplane was grounded for nine months for instrumentation changes. Once these were completed, a check flight was completed on 22 March 1971, after which the folding ventral fin was removed for four flights to assess directional stability up to Mach 2.8. NASA needed more aircraft, and the Air Force supplied an SR-71A (Article 2002 serial 61-7951) on 16 July 1971. For some unexplained reason, the Air Force stipulated that the aircraft had to be referred to by NASA as an YF-12C, and it completed its first flight with NASA on 24 May 1972.



The loss of YF-12A 60-6936 on 11 December 1969 generated the need for a replacement. The Air Force supplied SR-71A 61-7951 on 16 July 1971. (NASA)

Studies carried out on various aspects of the aircraft's handling qualities revealed that inlet spike movement and bypass door operations were almost as effective as elevons and rudders in influencing the aircraft's flight path at high speed. Propulsion system and flight-control integration was an aspect of control testing tackled by the NASA programme in an effort to improve future mixed-compression inlet design. Airflow disturbance often culminated in an unstart, and the accompanying aerodynamic hiccups could hardly be tolerated in a supersonic passenger aircraft. This work led Lewis Research Center to develop a throat-bypass stability system, which was successfully tested on the YF-12. It used relief-type poppet valves in the inlet that could react to internal airflow transients much faster than the bypass doors. This valve-stabilized airflow mechanism complemented the inlet control system by providing sufficient time for the inlet shockwave geometry to reconfigure itself to maintain a 'started' inlet.

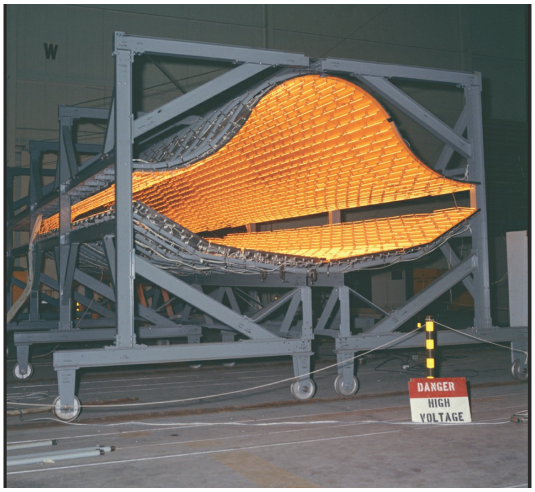
Another installation tested by NASA technicians and prepared by a Honeywell engineer proved so successful that it was later fitted to operational SR-71s – the Central Airborne Performance Analyzer (CAPA). This integrated automatic support system isolated faults and recorded the performance of 170 subsystems onto magnetic tape. Pre-and-post flight analysis of this onboard monitoring and diagnostic system proved highly cost effective and reduced maintenance man-hours significantly.

Between 1974 and 1976 a research programme was undertaken by NASA's

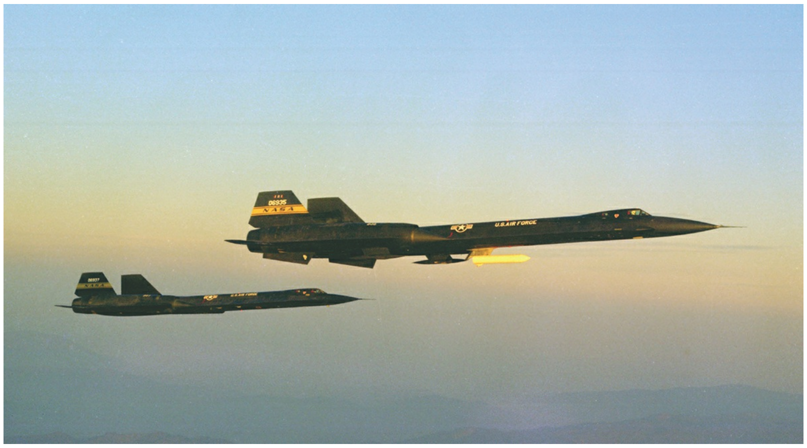
Langley Research Center to investigate and evaluate titanium and composite materials. The Skunk Works was the prime contractor for three wing panel samples evaluated. These lightweight structures consisted of a weldbrazed titanium skin-stringer panel, a Rohr bond titanium honeycomb-core panel and a boron aluminium-titanium core panel. All three components exceeded strength requirements.

06937
NASA
937
U.S. AIR FORCE

One condition governing the loan of 951 to NASA was that in addition to its being re-serialled 60-6937, it would also be referred to bizarrely as a YF-12C. (NASA via Tony Landis)



YF-12A 60-6935 was grounded for over a year between February 1972 and July 1973, during which time NASA conducted a series of structural heating tests utilizing thousands of quartz lamps. (NASA via Tony Landis)



During eight flight test sorties between October 1976 and October 1977, the remaining NASA YF-12A and 'YF-12C' flew together, with NASA 937 providing Mach 3 chase. Note the ceramic covering applied to the heat-transfer cylinder that was removed at cruise speed ballistically and the streamline camera housings under each engine nacelle to monitor the experiment. (NASA via Tony Landis)

SR-71B 61-7956 (NASA 831) is readied for an early morning training flight from Edwards. Note the JP-7 under the aircraft that has leaked from the 'wet' fuel cells. (Paul F. Crickmore)

One of the more unusual heat-transfer experiments supported by NASA was 'Coldwall'. For these test flights a hollow stainless steel cylinder was mounted under the fuselage of YF-12 6935 equipped with thermocouples and pressure-sensing equipment. It was then encased in a ceramic shell closed off at each end. Before flight, the cylinder was filled with liquid nitrogen to supercool it down to about minus 60°F. At Mach 3.0 the ceramic shell was ballistically removed, resulting in a classic heat-transfer experiment as the cylinder went from very cold to very hot almost instantaneously. Using the same cylinder, this experiment was then repeated in a wind tunnel, thereby validating ground research methods for future heat-transfer experiments.

Aircraft 60-6937 was retired from the programme after its 88th flight with NASA on September 28 1978. YF-12 number 60-6935 continued operating until the flight programme ceased after its 145th NASA flight on 31 October 1979. A week later, Col J. Sullivan and Col R. Uppstrom ferried the aircraft to the Air Force museum at Wright-Patterson AFB, Ohio, where as the sole example of the YF-12 it is on permanent display.

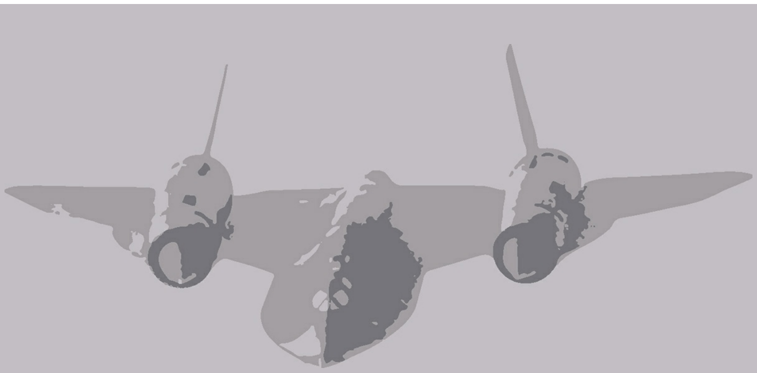
In early 1990, NASA once again became involved in operating the SR-71 when it was decided to conduct a number of aeronautical experiments requiring the use of a supersonic test platform. Three SR-71s were placed on loan by the Department of Defense, and in order to comply with Federal Aviation Administration (FAA) regulations, serial numbers were changed. SR-71B '956 became NASA 831, and SR-71As '971 and '980 became NASA 832 and 844 respectively. Like the earlier programme, this too was conducted from Edwards AFB, and first of the three aircraft to be readied for flight was NASA 831. The first of three training flights were conducted on 1 July 1991, after which Lt Col Rod Dyckman certified Steve Ishmael as a NASA instructor pilot (IP). Thereafter Ishmael checked out a second NASA pilot, Rogers Smith, who in turn flew Marta Meyer and her husband Robert on an orientation flight, as they became the two flight test engineers on the programme.

The final SR-71 NASA flight-test team from top to bottom was Rogers Smith, Ed Schneider, Bob Meyer and Marta Bohn-Meyer. (NASA)

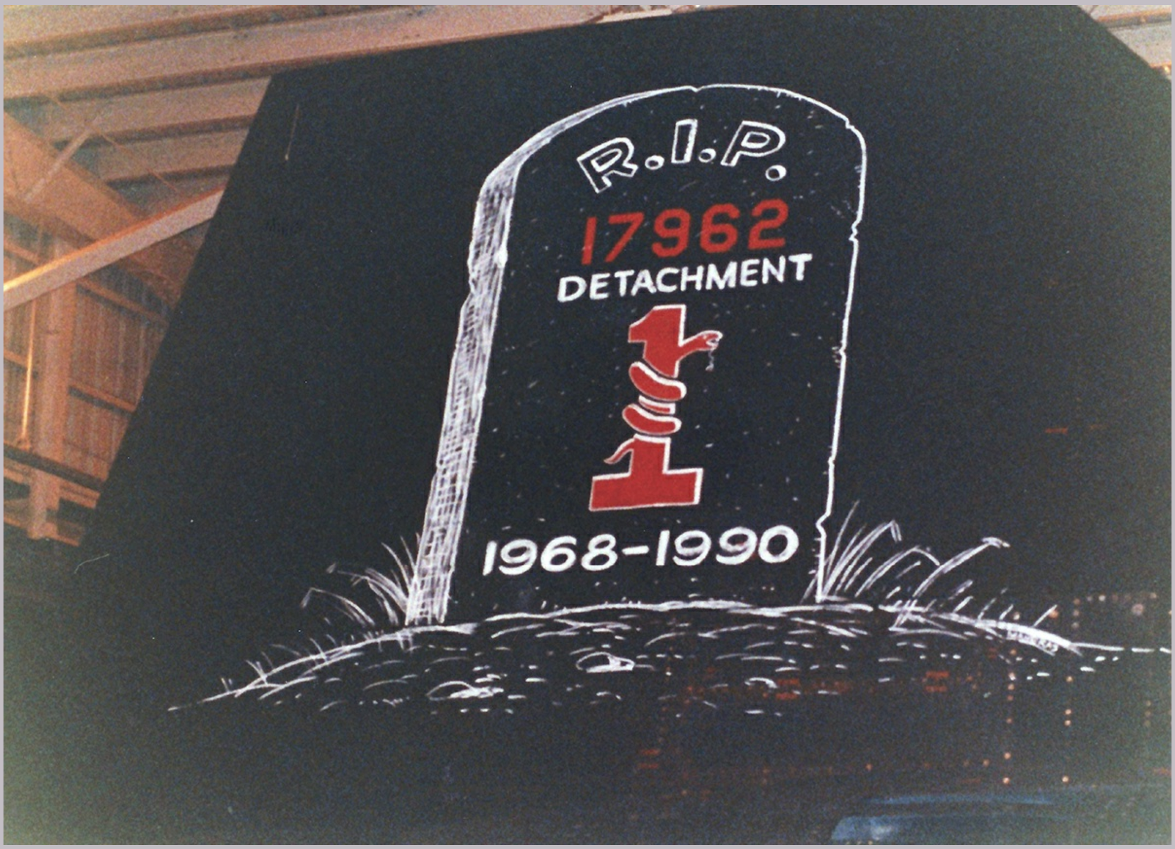
NASA 831 slides clear of the tanker during a crew training flight, flown on this occasion by Rogers Smith and accompanied by Marta Bohn-Meyer – Marta was the first and only woman to be part of the SR-71 flying programme. On the US unlimited aerobatic team for two years, Marta was tragically killed on 18 September 2005 while practising aerobatics. (NASA)

The most ambitious project to be conducted during this period was the Linear Aerospike SR-71 Experiment (LASRE). Its objective was to provide inflight data that would enable Lockheed Martin to validate the computational predictive tools it had been using to determine the aerodynamic performance of a future potential reusable launch vehicle. The first of seven flights got under way on 31 October 1997, and during this flight lasting 1 hour 50 minutes aircraft 61-17980 (NASA 844) reached a maximum speed of Mach 1.2 and 33,000ft before recovering back at Edwards AFB. A second flight successfully verified the SR-71/pod configuration, and five further flights were conducted focusing on the experiment. On 4 March 1998, the first of two flights were completed, during which time gaseous helium and liquid nitrogen were cycled through the Boeing-Rocketdyne J2-S linear aerospike engine. Three more flights were successfully completed in the spring and summer of 1998, during which liquid oxygen was cycled through the engine. However, numerous cryogenic leaks were discovered, and despite the engine being 'hot fired' on the ground on two occasions for a total of three seconds, it was deemed to be too dangerous to fire up the engine with its liquid hydrogen fuel while aloft. An investigation into the leaks determined that these would be too difficult and expensive to rectify, and in the event, sufficient information had already been gathered to predict the hot gas effects of an aerospike engine firing during flight: therefore the programme was terminated in November 1998.

The last flight of any SR-71 took place during the Edwards AFB open house weekend of 9/10 October 1999. On Saturday NASA crew Rogers Smith and Robert Meyer flew 61-7980 (NASA 844) up to a speed of Mach 3.21 and an altitude of 80,100ft. Unfortunately, it would prove to be its final flight, as the flight scheduled for Sunday 10 October had to be cancelled due to a maintenance problem.



CHAPTER 19:
SHUTDOWN



On 21 January 1990 Majors Steve Grzebiniak and his RSO Jim Greenwood ferried '962 back to Beale from Kadena AB. This creative piece of tail art said it all. Today this aircraft can be seen at the Imperial War Museum, Duxford, Cambridgeshire, England and is the only SR-71 that's on display outside the USA. (USAF via Don Emmons)

Two operating issues plagued the Senior Crown programme for most of its life, namely its high operating costs in comparison to other fixed-wing assets and the provision to fund those costs. Initially the cost-versus-benefit argument was straightforward to justify (particularly during the Vietnam War), on the basis that the detailed, broad synoptic coverage secured simultaneously by the platform's sensors was essential for both national and theatre commanders. The quality of 'the take' throughout the 1970s and early 1980s was superior to that acquired by satellites and its acquisition, more reliable and flexible. Furthermore, the SR-71's ability to secure such material, especially in high-threat environments, was beyond question.

THE COST OF DOING BUSINESS

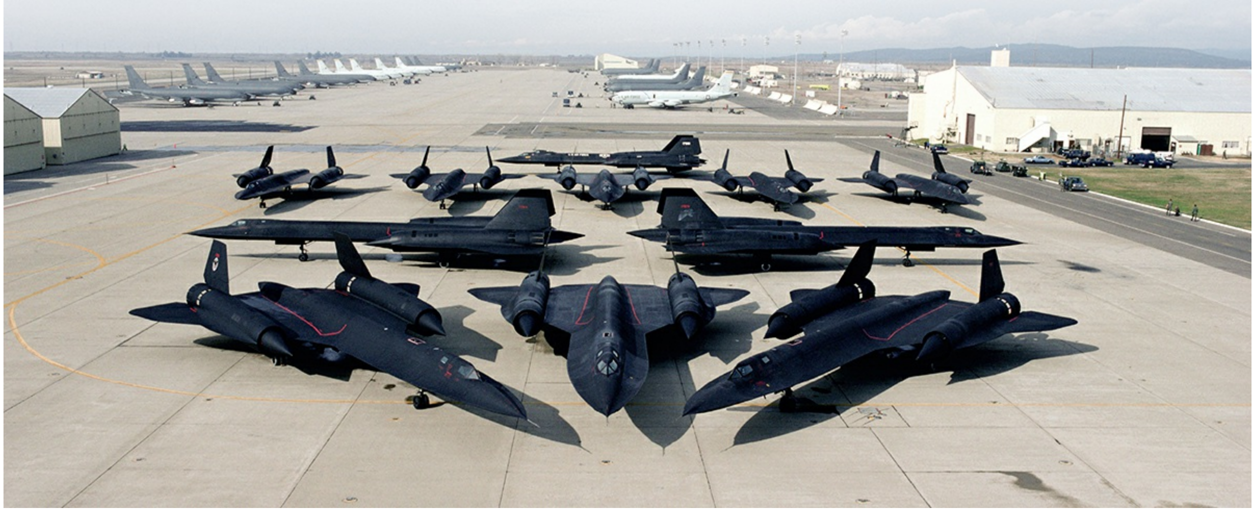
Senior Crown's programme element number at the Pentagon was PE 11133F (the first digit 1 denoted the major force programme as strategic). Initially DoD funding for this was provisioned for under a special 'black world' category. This protected funds for highly-classified programmes from scrutiny and also stabilized funding levels from cyclical budgetary raids that were the bane of 'white world' programmes. Transfer of the management of Senior Crown from the Air Staff Programs division to the Air Staff Operations division (XOORS) occurred shortly before August 1969. Then, in 1975, XOORS was redesignated XOORZ and SR-71 funding was moved from the black into the 'white world'.

From then on Senior Crown had to compete for its funding against all other DoD programmes. This situation generated two headaches for the SR-71's Program Element Monitor (PEM) at XOORZ. Firstly, the classified nature of the programme meant that it was designated Top Secret/Sensitive Compartmented Information (TS/SCI), which in practical terms meant that only those that were specifically cleared into the Senior Crown programme could be party to the intelligence it generated, which inevitably corseted the level of support the PEM could muster. The second issue was that the first digit in the programme element number, identifying Senior Crown as 'strategic', meant that it fell under the command of SAC, whose primary responsibility was to secure funding for two of the three very expensive legs of the nuclear triad – nuclear intercontinental ballistic missiles and its force of nuclear equipped B-52 bombers (a budgetary situation further exasperated by the need to upgrade both systems and introduce the B-1 bomber). Therefore, to some extent SAC's later anti-SR-71 stance is understandable, since they were saddled with its operating costs (which were considerable), while other government agencies, including the US Navy and US Army, who were major beneficiaries of its reconnaissance, contributed nothing to its upkeep.

Other Habus also had chalk tail-art applied at Beale after Senior Crown had been terminated. Here '980 carries the Det 4 insignia. (USAF via Tony Landis)

One of the vagaries of change in any large organization, especially at the top, is that the incumbent has his/her own agenda. Back in the days when the 'bomber boys' dominated USAF policy, it was very much a case of, 'If it doesn't carry bombs, I'm not interested' – a policy that some described as SAC-umcised! The ten Air Force Chiefs of Staff, from 1947 to 1982, all came from a bomber background. However, in July 1982, General Lew Allen turned executive leadership over to Gen Charles Gabriel and for the first time in its history, the Air Force had a boss with a fighter background. At the time it was widely expected that Gabriel would be succeeded by ex-SR-71 pilot (later 9th SRW commander and ultimately commander of Tactical Air Command), Gen Jerry O'Malley. However, on 20 April 1985 O'Malley was tragically killed in a freak accident. In an instant the Air Force lost not only a top leader, but also one of

Senior Crown's most powerful supporters. The SR-71 didn't feature in the non-O'Malley Air Force and thus the Air Force became a 'fighter-minded' service.



With the cooperation of Beale's base commander, Lockheed photographer Eric Schulzinger composed and took this historic masterpiece in February 1990. The SR-71 at the back is the hybrid SR-71C pilot trainer. (Lockheed Martin)

As a parting gesture to the 'Fighter Mafia' at the Pentagon, on 6 March 1990, '972 established a transcontinental world speed record from the west to east coast of the United States of 1hr 7mins 53secs. (Lockheed Martin)

Four years later, one of the Senior Crown programme's main detractors, General Larry Welch, became the Chief of Staff. His influential voice was joined by other prominent/influential figures voicing a similar anti-SR-71 stance. These included General Michael Dugan (AF/XO), General John Chain (CINCSAC), General Ron Fogleman (AF/Program Requirements), General Doyle (Chief of SAC Intelligence (SAC/IN)), Col Tanner (also of SAC/IN) and General Leo Smith of the Budget Review Board. Their assault on Senior Crown began from mid-1986, and the main reason that they cited for retiring the SR-71 was cost versus marginal benefits over satellites. But this was hardly a level playing field. Starved of funds, unlike the U-2, the SR-71's sensor systems hadn't been updated to include an electro-optical system for its cameras, neither had its Advanced Synthetic Aperture Radar System (ASARS) been connected to a datalink, which would have enabled real-time/near real-time transmission of its exceptional reconnaissance data directly to theatre commanders and if required, the national leadership.

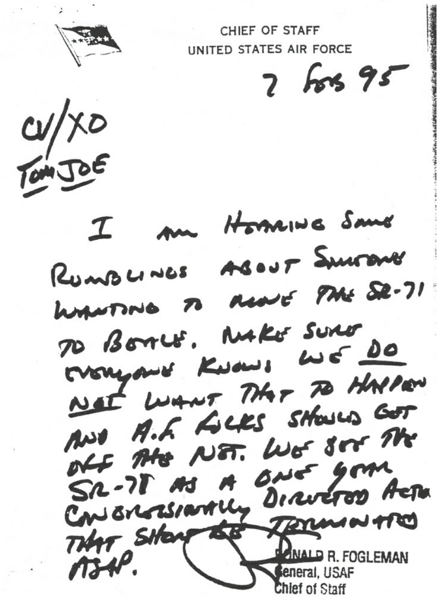
By 1988, it looked as though their efforts would be successful. However, Admiral Lee Baggot (CINCLANT) insisted that no other platforms (including satellites), were capable of gathering the vital intelligence he required regarding the movement of Soviet subs based on the Kola peninsula, and he took his battle right to the JCS and managed to secure funding for Det 4 for a further year. In addition, Lt Col Curt Osterheld (now a very resourceful SR-71 PEM at XOORZ) was able to secure the commitment from a staffer on the Senate Appropriations Committee, for $46 million that enabled Det 1 and the SR-71's logistics facility at Palmdale to remain open for fiscal year (FY) 1989.

SR-71 VERSUS KH-11

One SR-71 crew finding themselves at the 'pointy end' of the debate between satellites and the SR-71's capabilities was Maj 'Mac' McKendree and his RSO Randy Shelhorse, as Mac now explains:

> My interview at Beale for possible selection to the SR programme was in September '85. This consisted of two days of medical evaluation, two T-38 flights, a four-hour session in the SR simulator, several one-on-one interviews, and social gatherings. In conversation, the demise of the SR programme due to future new satellite capabilities was discussed. My options for an assignment at that juncture in my career were either a staff job at Langley AFB, or possibly pilot of the most

sophisticated, highest flying, and fastest manned aircraft in history. Did I really want to hitch my horse to that wagon? Well, yeah!



CHIEF OF STAFF
UNITED STATES AIR FORCE

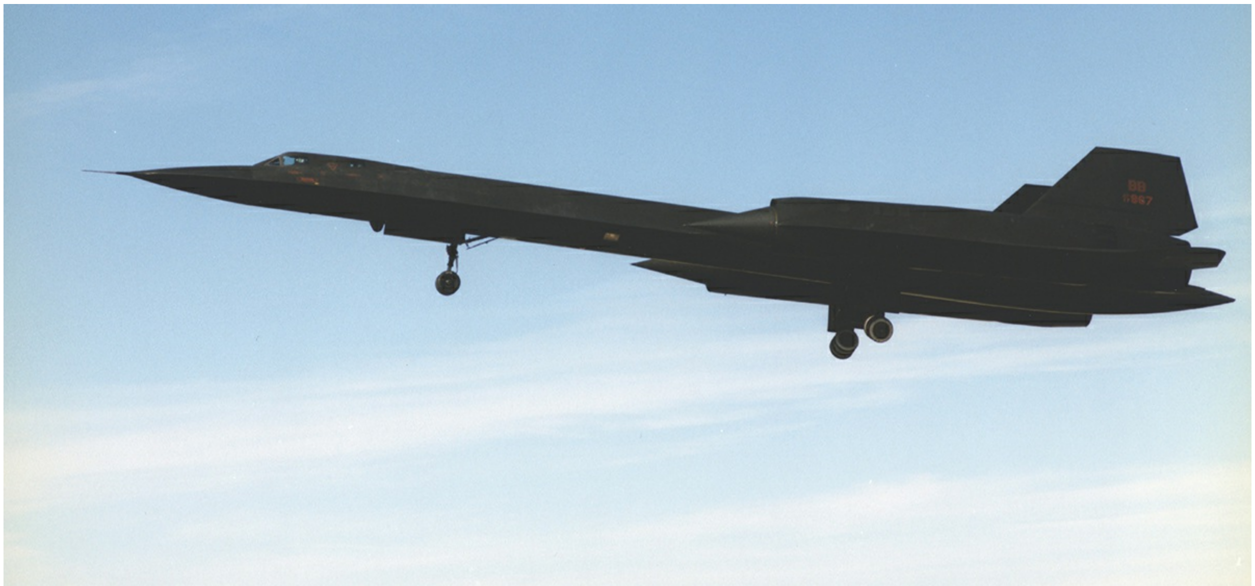
7 FEB 95

CV/XO
TOM JOE

I AM HEARING SOME RUMBLINGS ABOUT SOMEONE WANTING TO MOVE THE SR-71 TO BEALE. MAKE SURE EVERYONE KNOWS WE DO NOT WANT THAT TO HAPPEN AND A.F. FOLKS SHOULD GET OFF THE NET. WE SEE THE SR-71 AS A ONE YEAR CONGRESSIONALLY DIRECTED ACTION THAT SHOULD BE TERMINATED ASAP.

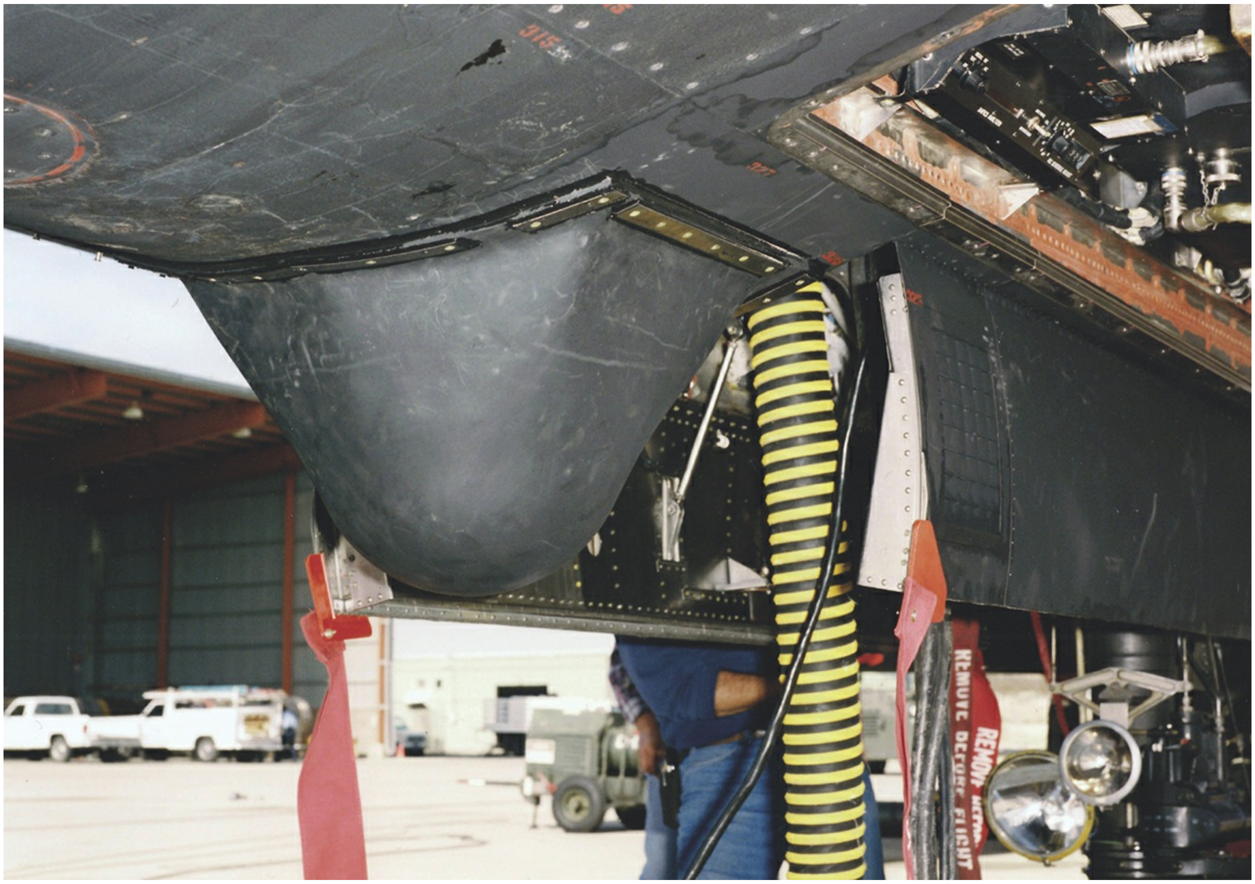
RONALD R. FOGLEMAN
General, USAF
Chief of Staff

General Ronald Fogleman, USAF Chief of Staff, ensures there's no ambiguity regarding his position, 'I am hearing some rumbling about someone wanting to move the SR-71 to Beale. Make sure that everyone knows we do not want that to happen and A.F. folks should get off the net. We see the SR-71 as a one year congressionally directed action that should be terminated ASAP.' One can almost hear the gnashing of teeth. (Paul F Crickmore)



'967 returns to Edwards – note the radome housing the datalink antenna just forward of the front undercarriage doors. (USAF)

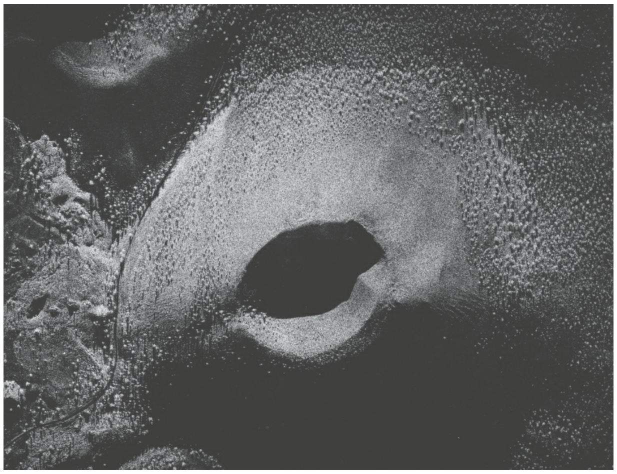
Now at Det 4 in March '89, during a six-week TDY, all was progressing at a normal pace when Lt Col Bill Orcutt, the 1SRS Commander, arrived unannounced via a KC-135 rotation aircraft. First thoughts among the two crews at Mildenhall were, who is in trouble and what do we do now? Randy Shelhorse and I were on top of the ladder to fly the next Giant Reach sortie, and as it turned out, Bill was there to oversee the planning, preparation, and mostly to impress upon us the importance of our next particular mission – the SR-71 versus a KH-11 satellite [during this time frame, there were three KH-11s in operational orbit, USA-6, USA-27 and USA-33]. The basic premise was to have both platforms image the same targets at the same time, to evaluate which had the highest resolution and functionality. The Advanced Synthetic Aperture Radar (ASARS) would be the primary sensor for the SR. Planning progressed as the Time Over Target (TOT) was dependent on when the satellite was in a position in its orbit to obtain data. The KH-11 would be looking relatively from south to north, while the SR would be collecting looking from north to south from over the Barents Sea.



The C3 Com datalink antenna was located below bay C. A digital cassette recorder system recorded both ASARS and ELINT data that could be transmitted in real time/near real time depending upon if the aircraft was within range of a receiving station. Senior Crown detractors starved the programme of funding thus ensuring that this essential capability was never made available until it was too late. (USAF)

Backing up from the TOT, our take-off time out of RAF Mildenhall came to 2:00am. Between tanker support and our departure, the local residents would certainly be deprived of sleep that night! All briefed and ready, word came down of a 24-hour slip. And then another 24-hour slip. Seems the 'Overhead Mafia' could not get their machine far enough north to be in position. Functionality…? Their solution: 'They' want the SR to fly at 15,000ft to have the same look-angle as their superior technology…Aaah – NO! [This last point demonstrates an ignorance of the SR-71's flight envelope that's jaw-droppingly inept at best].

By this time, the US Navy was in need of the delayed imagery of the Soviet Northern fleet and were demanding us to launch. Bill went over some last-minute details with Randy regarding abort criteria. So, at 2:00am on Monday 20 March 1989, we flew '964 on mission GR104G. Due to our launch time and the time of year in the Arctic Circle, the mission consisted of one night air-air refuelling and a Mach 3+ night pass through the collection area. This was followed by two daylight air refuellings and two further Mach 3+ day passes through the sensitive area. In the process we defeated numerous SA-2, SA-5, SA-10, SA-12 threats, along with outrunning and outclimbing four airborne interceptors (AIs), with data collected on all 95 targets. Our aircraft, SR-71 17964, returned to base Code 1 [no write-ups]. Mission duration, 3.8 hours. We received no word on the results of compared imagery – if there ever was any to compare our data to!

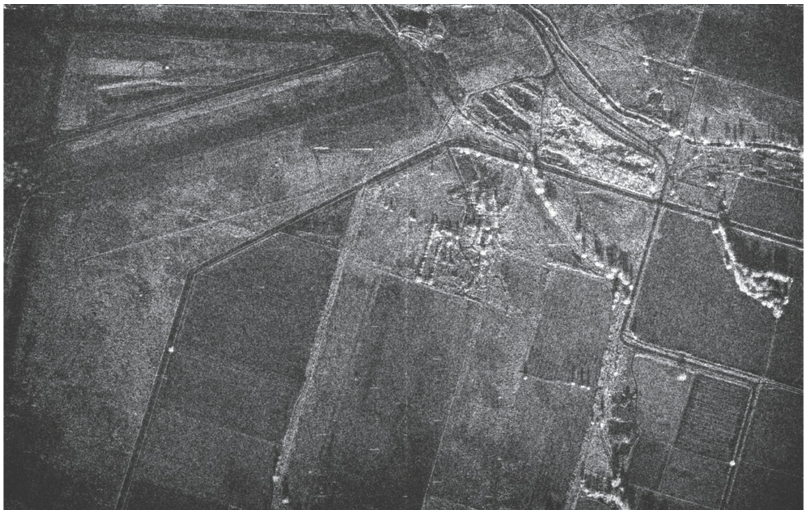


This selection of hi-res ASARS I images were taken during SR-71 test sorties. In this digitized format such images could be transmitted via the datalink to ground commanders in real time/near real time. This is Sunset Crater. (Goodyear)

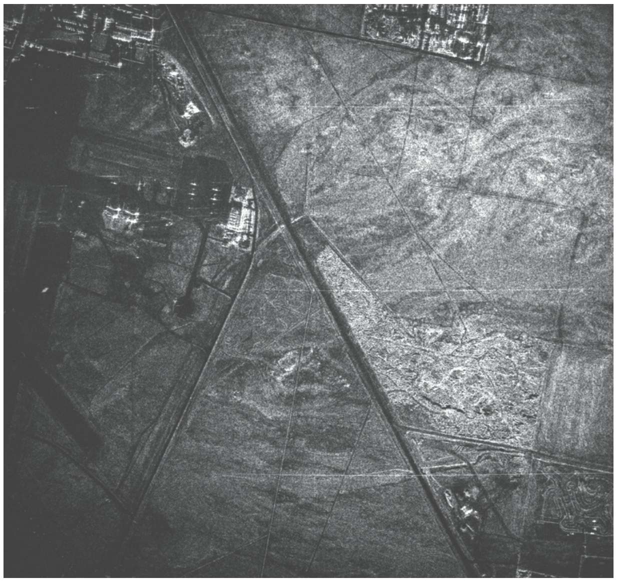
When President George H. W. Bush nominated Dick Cheney for the office of Secretary of Defense on 21 March 1989, it was yet another nail in the coffin of the SR-71 programme. It is believed that Cheney was biased against the SR-71 programme after his participation in the House Permanent Select Committee on Intelligence (HPSCI) which favoured the expansion of satellite operations. As the end of that fiscal year approached, the future of the programme looked increasingly bleak, and on 1 October 1989 all SR-71 operations were suspended with the exception of a minimum number of proficiency flights. Finally, on 22 November, despite the misgivings of 40 members of Congress, including chairman of the Senate Committee on Armed Services, Senator Sam Nunn, Senior Crown was terminated. Two months later, on 26 January 1990, the SR-71 was officially decommissioned in a ceremony at Beale AFB – the programme's detractors had finally won the day. What was to be the Air Force's final flight of an SR-71 took place on 6 March 1990, when Ed Yeilding and J. T. Vida flew '972 on a west to east coast record-breaking flight of the United States, before landing at the Smithsonian National Aerospace Museum, Washington DC, where it was handed over for permanent display.

As for the SR-71 crews, 1st SRS Commander Lt Col William 'Rod' Dyckman explains,

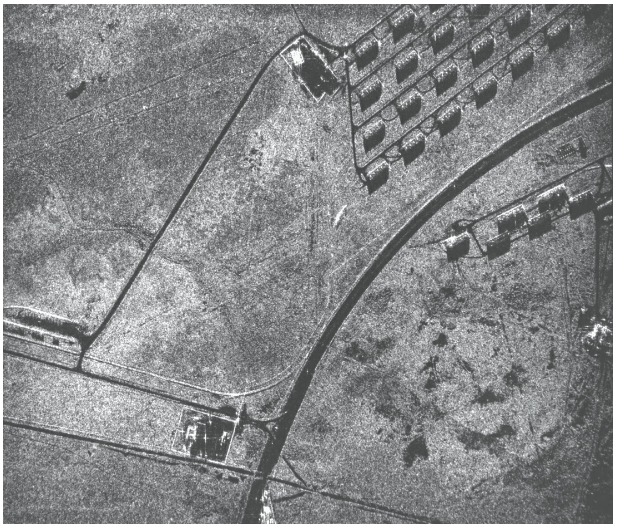
> At my level, I only saw the results of the politics. I saw discrimination against the officers in my squadron during the assignment process and on the promotion board to Lt Col. In spite of the fact that my squadron consisted of a highly competitive group of officers, all but one of these officers was passed over for Lt Col! In addition, finding suitable follow-on jobs for my squadron's officers was challenging. They were eventually all placed, albeit many in jobs beneath their skill level and certainly not always in desirable positions.



This 3ft x 3ft Spotlight ASARS I image captures an area 6,100ft x 6,100ft. (Goodyear)



Part of Nellis AFB imaged by ASARS I on a 3ft x 3ft Spotlight setting. (Goodyear)



This selected enlargement demonstrates the step change in image resolution attained by ASARS I. (Goodyear)

Putting this into context, six majors involved in flying the gruelling 11hr Giant Express missions over the Gulf were passed over, whilst the Base Operations major made Lt Col, thereby recording just a 14 per cent promotion rate, while the U-2 rate was 100 per cent. This is not to decry the vital work conducted by those equally professional aircrews, or that carried out by base operations personnel throughout the Air Force, but rather it illustrates the level of toxicity pervading the corridors of power at that time towards flight crews that served their country in the SR-71 programme. Several pilots' assignments were career-ending, so unsurprisingly, they left the Air Force soon afterwards to fly for the airlines.

In compliance with the decommission decision, three SR-71s were placed in storage at Air Force Site 2 Palmdale. Two other 'A models', together with the sole surviving two-seat trainer, '956, were loaned to NASA as supersonic test platforms to be flown from Edwards AFB. Virtually all the remaining aircraft, including the surviving A-12 Oxcarts, were cut up, moved and reconstructed as exhibits at various museums throughout the United States.

The vital task of monitoring the Soviet boomers of Northern Fleet that represented such a grave threat to the United States and its NATO allies was bestowed upon the U-2s of the 17th Reconnaissance Wing, 95th Reconnaissance Squadron, based at RAF Alconbury, England. Codenamed Olympic Distant, these missions were extremely demanding with a typical flight duration of 11 hours. The first Distant Olympic mission was flown after the termination of Senior Crown, however, the sortie rate was dropped to just one a month, a far cry from Det 4's 2–3 a week – one can only imagine the US Navy's response! The last U-2 mission up to the frozen northern wastes was flown two years after the end of Gulf War 1, on 6 May 1993 in aircraft serial 1095, by Lt Col Joe Muus.

On 2 August 1990, Iraq invaded Kuwait and within days of the invasion Ben Rich (now President of the Skunk Works) phoned General Michael Loh, Air Force Vice Chief of Staff, and informed him that he could have three SR-71s ready for operations over the Gulf within 90 days. General Loh committed to floating the idea and getting back. But about a week later, Rich received a call saying that SecDef, Dick Cheney, vetoed the idea, commenting along the lines, 'I retired that aeroplane once, I'm not going to do it again. If I bring it back now, I'll never get rid of it'. That *Desert Storm*, the subsequent Allied operation that ousted Saddam Hussein's forces from Kuwait, was a spectacular success, is beyond dispute. However, one of the lessons learned from the 41-day campaign was that there was a lack of timely reconnaissance material available to General Schwarzkopf 's field commanders, a gap that could have been bridged by the SR-71, as 'Mac' McKendree confirms. 'After the SR programme, I went back to TAC flying EF-111s, only to find myself in Saudi Arabia during Desert Storm.

After the ceasefire, I escorted RF-4s on multiple sorties doing post-strike recon. All of which could have been done on one SR sortie.'

The limited capability SR-71 reactivation plan began on 5 January 1995, when '967 undertook a fuel leak evaluation. The aircraft finally completed a successful FCF on 12 January 1996. (Jim Ross/NASA)

Further discontent about the decision to terminate Senior Crown re-emerged during the spring of 1994, when relations between North Korea and the United States sank to another low over the North's refusal to allow inspection of their nuclear sites. This action prompted Senator Robert Byrd and several members of Congress to contend that back in 1990 the Pentagon had consistently lied about the supposed readiness of an SR-71 replacement. Their campaigning paid dividends, as noted in the Department of Defense Appropriation Bill 1995 dated 20 July, when $100,000,000 was made available for the reactivation of a modest (three-plane) SR-71 Blackbird reconnaissance aircraft contingent for intelligence operations as recommended by the Senate Armed Services Committee. Furthermore, in an unprecedented move, their report went on to detail how and where the money was to be spent during that first year, including co-locating the new detachment at Edwards AFB in order to share some operating facilities with NASA, thereby helping to reduce costs, as well as implementing a robust sensor update programme.

On 1 February 1996, '971 participated in Red Flag, and on 14 June 1996, while being flown by Ed Schnieder and Blair Bozek, the ASARS I data transfer link was successfully demonstrated. (Jim Ross/NASA)

Recognizing the utility of the aircraft's systems to both national and tactical intelligence commanders, the Committee also directed that costs should be evenly shared by the intelligence community and the Tactical Intelligence and Related Activities (TIARA), budget. The conferees went on to reaffirm their support for the goals and objectives of the department's endurance unmanned aerial vehicle programme, and further directed that the SR-71 programme be wholly designated as a TIARA programme and that the Air Force assume total responsibility for sustaining out-year budget requirements.

The scale and detail of this Congressionally Directed Action or CDA is astonishing, and no doubt acted as a red rag to a bull to those senior Air Force officers that had worked so tirelessly to terminate Senior Crown. In a memo to the Deputy Chief of Staff, Plans and Operations USAF, from the Director, DARO [the Defense Airborne Reconnaissance Office is responsible to the Under Secretary of Defense and was created in November 1993 to provide increased support from senior management toward airborne reconnaissance systems], Major General Kenneth R. Israel, dated 24 October 1994, the latter pointedly recognized that 'currently, no funding has been identified for FY1996 and out'.

Of the three platforms placed in deep storage at Palmdale, only 61-7967 was called to arms by the Air Force. Aircraft reactivation began on 5 January 1995, when '967 undertook a fuel leak evaluation. Seven days later, at 11:26am, NASA crew Steve Ishmael and Research Systems Operator Marta Bohn-Meyer got airborne from Edwards in '971 on a 26-minute ferry flight that terminated at Lockheed Martin's Skunk Works, Plant 10, Building 602, Palmdale. Over the next three months, ASARS, together with other sensors previously in storage at Luke AFB, Arizona, were installed. At 10:18am on 26 April, NASA crew Ed Schneider and Marta completed a 34-minute FCF on '971. A month later Ed and Marta's husband Bob Meyer conducted '971's second and final FCF, which lasted 2½ hours. However, it took seven further check flights to wring out all the glitches in '967, the final one being successfully completed on 12 January 1996.

On 16 July 1997, Majors Tom McCleary and his RSO Jim Greenwood departed Beale in SR-71A '971. The mission flown within the United States was to evaluate a film then being developed. This image was taken by one of the aircraft's TEOCs, loaded with standard 3412 black and white film. (McDonald Douglas via Chuck Hamilton)

Three Air Force crews were selected to fly the aircraft. To save money, the plan was that two crews would always be 'mission ready' qualified, while the third crew would be 'mission capable'. While crew proficiency training got under way in the simulator and the 'B' model, R&D funds were used to develop and install the long-awaited datalink, which was manufactured by C3 Com. of Salt Lake City; its antenna was housed in a small radome just forward of the front undercarriage wheel well referred to as 'the wart'. A digital cassette recorder system (DCRsi) provided recording and playback of both ELINT and ASARS data, enabling the SR-71 to provide near-real-time data provided it was within 300nm line-of-sight range of a receiving station; if not, the entire recorded collection could be downloaded in 10 minutes once within station range. Also under development was an electro-optical version of the TEOC, the aim of which was to also provide a digitized image that would also be downloaded in a way similar to the ASARS I imagery. This initiative was undertaken by Recon Optical, and the project lead was Nance Romans.

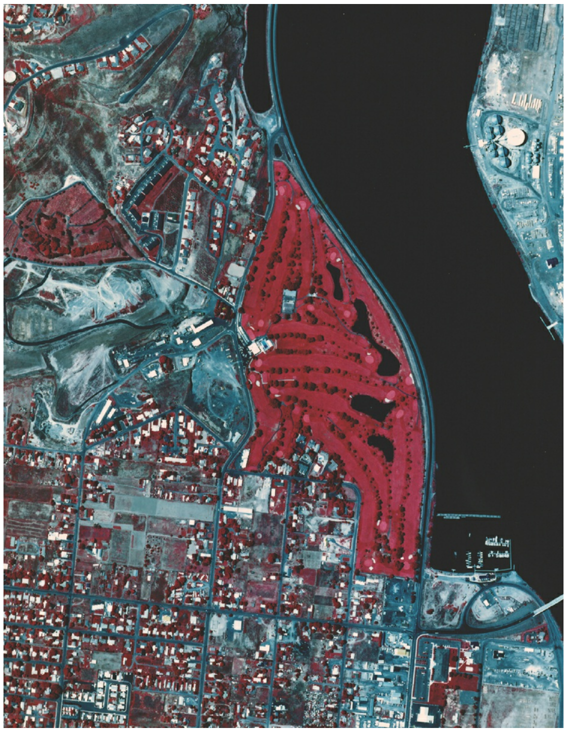
Underpinning much of the reactivation work in the field were two ex Habus, Don Emmons and Barry MacKean together with Major Mike 'Z-Man' Zimmerman, whose background for the most part had been working special projects within the Big Safari Programme in Air Force Materiel Command (AFMC). Mike was made right at home by the ex Habus, and soon came to realise what they were all up against. But having concluded they were in with a chance of making the tight 1 September '95 Initial Operating Capability (IOC) deadline set by the Air Force, Mike first identified the major points being cited by the 'fighter mafia', as to why the SR-71 shouldn't be returned to operational service and then to systematically began to address and dismantle those arguments as he recalls,

> No programme manager ever plans on failing, so when I was selected to take on the reactivation programme, I had the immediate hurdle to return the aircraft and systems to operational status. As plans were made to put the programme back together, we also looked at areas that could be improved just as a matter of bringing the programme back. If we wanted any chance of being continued into the future, we had to address the major detractors that were used against us. The major ones were 'it's too expensive to operate, the systems on board cannot be used with the current intelligence networks making its contribution not timely, and the size of the deployment package was so large it used up too

many Air Mobility/Air Combat Command recourses.' The last two contributing greatly to the overall costs.

Since 2 A and 1 B model aircraft, simulator, and spare parts were all loaned to NASA as part of the shutdown, I also had the additional concern from NASA as to the impact of the reactivation on their current projects. The NASA team seem relieved, but cautious, when I said we would 'cooperate and graduate' sharing resources so our reactivation could coincide with their programme to reduce costs.

So, right from the beginning, we sent funding to NASA to begin the initial co-use tasks under their authority. We identified differences in how the organizations operated the jets. Our first risk to both programmes was the small amount of tank sealant available and no readily available source to make more. So, one of my first contract actions was for the 3M company to make more. Because of all of the new regulations and EPA rules, we could only make one lifetime (5–10 years) batch. NASA now had access to new sealant and if shut down again, they would be set for the life of their programmes. Another example was updating the ANS (Astro Navigation System). The 'Star Charts' or celestial data needed to constantly and accurately provide air navigation information not only for the crew, but also as inputs to the all of the intelligence systems on board. So, once again, it was cheaper and prudent to get a 10-year update.



This image taken by 971's other TEOC shows an identical area of Lewiston, Idaho, but filmed on 2443 infrared film. This has the ability to discern live or dead vegetation (live is coloured red), thus revealing camouflaged areas. (McDonald Douglas via Chuck Hamilton)

During the early 1980s the Air Force began a major modification programme on its tanker fleet, replacing the old Pratt & Whitney J57 turbojets with four new CFM56 turbofans (designated F108-CF-100 by the military). The resulting KC-135R was more powerful, quieter and far more fuel-efficient. Tests completed with the SR-71 indicated that the new tanker was able to increase its maximum speed by an additional 20 KIAS, allowing the SR-71 to refuel at 375 KIAS – a considerable improvement, especially during heavy-weight operations. (Blair Bozek)

We handled the 'too expensive' argument by looking at the original programme and finding ways of doing business cheaper. Instead of organic, completely Air Force maintenance, we used contractor support to the maximum amount possible. This gave me a fixed bill for each year we were active. So, for manpower, the more hours we flew, the cost per hour went down. Because the SR-71 had many aspects declassified, it was easier to work with other organizations. If we had some parts or systems that were common with the U-2 or another programme, we tried to combine our requirements so that both programmes could benefit from quantity purchases.

Congress added a datalink requirement shortly after we started. The SR-71 didn't have a link in 1990, so we went looking for ways to install the capability. We found an old U-2 datalink that wasn't being used operationally. It wasn't a common datalink that could talk to other DOD systems, but if we could modify it to be common, I would have plenty of spares and ground support equipment. Most importantly, I could answer the interoperability questions and our ASARS imagery could be made available to the warfighter in the matter of minutes/hours vs days/weeks. Converting the TEOC cameras from film to electro-optical allowed us to link both our ASARS and camera products to ground systems around the world. To accommodate the other ground systems to process our ASARS imagery, we updated the ground processor from 3 tractor trailer vans to a plug-in system that was

> about the size of 5 suitcases. This alone allowed us to reduce our deployment footprint by 2–3 C-141 load equivalents, thus saving costs here also. Our successes made it easier for Congress to extend our funding, at least for one year.

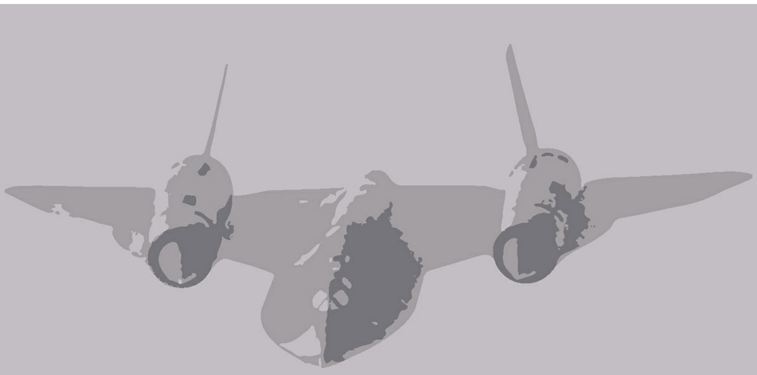
But the CDA had created an immense amount of resentment amongst several members of Congress and key AF officers, including none other than the now USAF Chief of Staff, General Fogleman. Det 2 was operationally ready to deploy, but they were never tasked to do so by the Air Force. Basically, senior AF figures were planning for a 12-month womb to tomb scenario, believing that Congress would be unable to push through additional funding for a second year. However, against the odds, $35 million of further funds were appropriated for the SR-71, as noted in the National Defence Authorization Act for FY 1996: 'The committee is pleased with the timely and cost-effective reconstitution of a contingency force manned, high speed, penetrating reconnaissance aircraft as a hedge until penetrating unmanned aerial vehicles are more widely fielded.'

Despite monies being appropriated, significantly, there was no mention of it in the Senate Authorization Bill. Furthermore, when a staffer on the House Select Committee on Intelligence pointed out that section 504 of the 1947 National Security Act actually prohibits the obligation of funds for intelligence activities not specifically authorized, this was taken up in a meeting of Congress in December 1995. The Air Staff were left to debate where this technicality left the SR-71, given that the budget was split between two pots of money – Aircraft Procurement and Operation & Maintenance. With conflicting guidance coming from Congress on how section 504 should be interpreted, lawyers became involved, after which it was determined that in order to comply with the letter of the law, SR-71 operations had to be suspended. A signal was therefore dispatched to that effect at 23:00(Z) on 16 April 1996, and all Air Force SR-71 flying ceased yet again.

While grounded, two classified requests were made for SR-71 operations, but both were denied based upon the interpretation of intelligence laws. But with members of the Senate Appropriations Committee enraged at the way they'd been circumvented over the decision to suspend SR-71 operations, they made it known that if their bid to secure $30 million worth of funding for the SR-71 was obstructed, they threatened to have section 8080 of the Appropriations Act eliminated. After this, their next tactic would have been to get the Intelligence Authorization Act for FY97 defeated on the House and Senate floors, which in turn would have led to the suspension of *all* intelligence activities! Perhaps not surprisingly, the bill was passed and flying resumed once more. However, by now the 'powers that be' in the Air Force had had enough of 'unwanted intervention' by Congress in 'their affairs' and when the White House insisted that the Pentagon find savings in the defence budget, senior AF officers seized their opportunity and offered up the SR-71. On 14 October 1997 President Bill Clinton line-item vetoed the programme, and with immediate effect, all Air Force Blackbird flying ceased, this time permanently.

In yet another twist later that year, the US Supreme Court ruled that the line-item veto was unconstitutional. Two other programmes that fell victim of this veto process were reinstated by the Air Force – not, however, the SR-71. Yet again, elements within Congress stood their ground, stating that funds totalling $39 million were available for the programme and demanding to know the source of the hold-up. However, when required, the bureaucratic process can be made to slow to the pace of a snail on Valium, and by stalling, on 1 October 1998 (the start of FY 1999) whatever funding that had remained was exhausted. The SR-71 wasn't in the budget and it was all over for good.

Throughout all the political shenanigans during the reactivation of Det 2, the SR-71 flew a total of 150 training sorties, that accumulated 365.7 flight hours. The final Det 2 SR-71 sortie was flown on 10 October 1997 in aircraft '967 on training route Brandy, which lasted 4.1 hours.



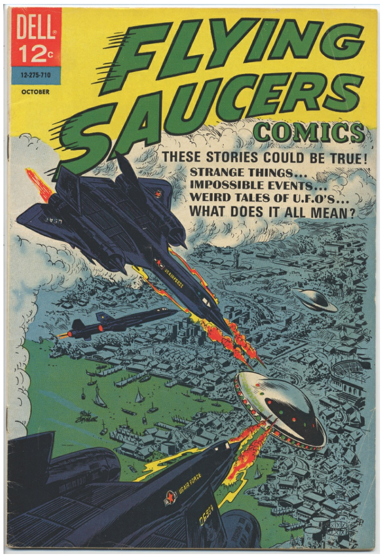
CHAPTER 20:
LEGACY

A truly iconic aviation legend. (Lockheed Martin)

Throughout the history of aviation, there have been thousands of forgotten aircraft, hundreds which have been easily recognisable, dozens which have been considered ‘classics’, but only a few which have become genuine icons. The Spitfire and B-17, for example, are iconic representations of World War II, the 747 and Concorde are icons of the age of luxurious jet travel, and the B-52 is the instantly identifiable icon of the Cold War (and especially the war in Vietnam). Not surprisingly, a pair of Lockheed aircraft designed by the iconic Kelly Johnson have become synonymous with Cold War strategic aerial reconnaissance, both in the aerospace design world as well as across historical representation, military achievements, and even pop culture. It is not an overstatement, then, to refer to both the U-2 and the SR-71 as icons – indeed as legends – in the evolution of flight, intelligence collection, and in the public imagination.

According to my dear departed friend, SR-71 Chief Test Pilot Bob Gilliland, Kelly Johnson was fond of saying ‘I’m a primadonna and I’m surrounded by primadonnas’. When Kelly designed the SR-71 back in the 1960s, he gave the prototype an in-house article number of 2001. As you might expect, this wasn’t a random number plucked from the ether but the result of his extensive knowledge of aeronautical and threat developments, upon which he predicted that the SR-71 would remain immune from interception until at least the year 2001. On this rare occasion, however, he was wrong, as his masterpiece wasn’t rendered redundant by an advanced defensive weapons system developed by an unfriendly power, but rather by opponents of the Senior Crown programme within the US Air Force, the US intelligence community and even Lockheed, a move surely even Kelly couldn’t have foreseen.

It’s almost impossible to exaggerate how this aircraft programme was responsible for driving technology forward in so many different fields. As detailed in Chapter 9, the operational requirement to develop a survivable platform capable of flying at sustained extreme heights and speeds meant that thermodynamic and weight considerations were pivotal in its design. These led to the decision to build the Blackbirds from titanium, a leap into ‘the technical unknown’ and with its raft of challenges from fabrication to drilling holes, welding and attaching various elements of the structure together. The Blackbird’s forerunner, the U-2, was certainly revolutionary, but this programme was altogether more complex – and expensive!



Front page of the October 1967 edition of *Flying Saucers* magazine had three F-12s intercepting flying saucers – maybe the aliens were en route to visit friends staying at Area 51! (via Tony Landis)

Another 'Blackbird' operational requirement was that the aircraft should be 'invisible to radar'. As a result, it was also the first operational military aircraft that pioneered the concept of incorporating techniques and technologies to reduce its radar cross section (RCS), right from the get-go. The result was an aircraft which for its size generated a much-reduced RCS. As documented in the Oxcart chapter (Chapter 3), the CIA's project Palladium determined the various RCSs required to ensure that an aircraft remained 'invisible' to the different radar types. However, it would be another 15 years before 'stealth' could be exploited to a level that 'provided an explicit operational advantage'. Such a breakthrough came with the development of computer miniaturisation and rapid data processing, thus making possible fly-by wire (FBW). This enabled aerodynamically unstable aircraft shaped to reduce their RCS to remain stabilized by computers throughout their flight envelope without pilot involvement. The other important development in making 'stealth' possible was powerful computers, capable of predicting the behaviour of different radar types when exposed to different aircraft shapes (the first successful operational applications of this were of course the in-theatre Lockheed Martin F-117 Nighthawk and the inter-continental Northrop Grumman B-2 Spirit). As it was, the Oxcart was tracked briefly during its third operational mission (BX6705), just as Kelly Johnson (and the CIA's ELINT Staff Office (ESO)) had predicted.

With his ‘Blackbirds’, Kelly and his equally talented team of Skunk Works engineers created an aircraft of jaw-dropping wonderment that exuded gravitas, beauty, elegance and futuristic lines. But that’s only part of the story. Pratt & Whitney’s J58 dual cycle turbojet/ramjet engine was vital to the programme’s success, as was the integration of the asymmetric mixed-compression, variable-geometry inlet and convergent/divergent blow-in door ejector nozzle.

The engine couldn’t have operated in its designed envelope without the development of its bespoke JP7 fuel, which in turn wouldn’t have been able to ignite on start-up without TEB. So the list goes on, continuing with the requirement to develop and produce an autonomous, highly accurate astro-inertial navigation system. Without the development of high-performance cameras, film and radar sensors, the aircraft would have been unable to do its job. The AIM-47 missile and its associated Fire Control System developed for the YF-12 took Doppler radar to previously unheard-of levels. Perhaps one of the Blackbird’s more overlooked achievements was its ability to act as a high-speed, high-altitude launch platform with the D-21 drone and NASA’s Linear Aerospike SR-71 Experiment (LASRE). Indeed, the list is almost endless, but at the root of and driving all these outstanding achievements were the multiple platforms based on Lockheed’s Blackbird designs.

OXCART

Less than three months after Lockheed signed the contract with CIA to build 12 A-12s, the Soviet Union shot down a U-2 with an SA-2. The political ramifications were immense: the United States banned manned overflight reconnaissance of the USSR, so consequently the A-12 never conducted the mission for which it had been originally designed.

Instead of serving in its intended role of strategic reconnaissance aimed at America’s Cold War foe, the decision was taken to deploy three A-12s to Kadena in a purely tactical reconnaissance role to ascertain if North Vietnam had received surface-surface missiles. One might argue that this indirectly informed US leaders of possible Soviet or PRC participation on behalf of the DRV, thereby avoiding the risk of superpower confrontation should any of these ex-patriot forces be killed, but this remains a tenuous stretch from a tactical requirement to a strategic undertaking. The decision to utilize the A-12 was based upon the inability of any other platform to execute the required mission. Once in theatre, the A-12 proved itself to be a reasonably reliable and extremely capable platform (especially given its advanced and arguably unproven technology), able to successfully undertake missions in an exceptionally high-threat environment. Despite these initial accomplishments, the weather patterns of Southeast Asia had a seriously detrimental impact on the planned Oxcart mission rate, plunging from the planned nine per month to an actual average of just 2.4 per month over its 12-month operational life. A major factor behind this was the platform's PHOTINT only capability. Given the poor resolution of Sideways Looking Airborne Radars (SLARs) of the day (about 10ft from 80,000ft), it's highly unlikely that Oxcart could have fulfilled its surface-to-surface, missile-seeking task even if it had been equipped with a SLAR.

Majors Lee Shelton and Russ Szczepanik brief the then Prince Charles, of note is the crew's dark-blue, short sleeved 'air display' flight suits unique to Habu crewmembers. (USAF)

The fact that the Oxcart programme was cancelled after just 29 operational missions was largely a political one, grounded in financial considerations and not the inability of the vehicle to conduct its mission. Moreover, the A-12 was immediately replaced by its cognate successor – SAC's SR-71 – reflecting both satisfaction and confidence in the airframe and its capabilities.

Whether or not Oxcart's success over Hanoi – the most highly defended area in the world at the time – would have translated to similar success over the USSR or PRC remains speculative. The proposed 1967 A-12 Upwind overflight of Finland to assess the Tallinn SAM system clearly avoided any incursion over the USSR both for safety and political reasons. The concurrent use of overhead systems obviated the risk of manned reconnaissance over the USSR. Given Kelly's accurate prediction of the evolution of Soviet SAMs and that the Oxcart would be tracked, it is fortunate that there was no test of its capability to successfully overfly the Soviet Union.

TAGBOARD

The M-21, D-21 Tagboard programme was an innovative way of obtaining reconnaissance of targets located deep within denied territory. It also neatly circumvented the ban on *manned* overflights at a time when satellites were still in their infancy.

To critique this high-risk programme, it's probably best to defer to Kelly Johnson's notes. He was concerned about the tight launch parameters between the mother/daughter combination, and he kept SAC officials appraised of the programme's progress from an early stage. When a second order for 15 D-21s was placed in April 1966, Kelly noted in his diary, 'This time I have proposed the use of the D-21 with a rocket launch from the B-52. Our problem now will be to get wide usage of this new bird at low cost', and this was the crux of the problem. The D-21 was an expensive, one-flight-only platform of dubious reliability, which was unable to successfully address the cost versus benefit equation, let alone consistently deliver the desired collection.

KEDLOCK

The YF-12, together with its Hughes AN/ASG-18 fire control and AIM-47 missile system undoubtedly proved themselves in tests to be a winning combination. Aerospace Defense Command believed that 96 F-12Bs would be enough to defend the entire United States against a Soviet bomber attack. But the system was extremely expensive and the programme became embroiled in a bitter political fight between the Air Force and the Secretary of Defence Robert McNamara over the appropriation of defence funds.

In addition, Kelly Johnson's concept of a 'Universal airplane', i.e. the same basic design that with moderate manufacturing changes could be a bomber, a fighter or a reconnaissance platform, seemed eminently sensible from an operator's and manufacturer's perspective but worried some DoD officials, who were uncomfortable about putting all their eggs in one manufacturer's basket. Curiously, this presaged the interservice TFX debacle where McNamara wanted a single airframe with variations to enter multi-service operation. Indeed, an R-12, an F-12, and even a B-12 would have been consistent with this vision. However, LeMay surprisingly sided with McNamara, seeing Kelly's B-12 as a threat to the B-70.

Furthermore, in 1960 over 780,000 Americans worked in the aviation manufacturing industry, with 39 per cent of them based in California. The remaining 60 per cent of the American aviation workforce rightly expected their member of Congress to secure contracts that would keep them employed and avoid one that would keep everything tied up with one Californian-based company, namely Lockheed. As with Oxcart, the YF-12 became another political casualty.

SENIOR CROWN

Although it never had to undertake its 'Hot War' role within the Single Integrated Operational Plan (SIOP), the SR-71 performed a vital intelligence gathering role throughout the world for 21 years. The high concentration of SA-2s around Hanoi and Haiphong meant that there had been no-go areas for the U-2 since 1966. The Blue Springs high altitude RPV programme was experiencing an exponential level of attrition and it was still the early days of the satellite programme, which was delivering promising but sketchy coverage. The fate of the Oxcart programme was sealed, once it was determined that the SR-71 would replace it over North Vietnam. It was here that the aircraft proved that it was indeed a platform capable of surviving in a high-threat environment. Beyond this, it was the catalyst that drove the development of new and improved camera and ground scanning radar systems. These improvements coupled with a more streamlined, in-theatre processing structure ensured that the intelligence product was delivered rapidly to relevant theatre commanders and to national decisionmakers.

With cameras stationed in chine bays and an SLAR in its interchangeable nose section, the SR-71 boasted the ability to provide simultaneous, synoptic coverage of a target area (PHOTINT and RADINT) which Oxcart could not. Its SLAR system was continually upgraded throughout the life of the programme, culminating in the operational deployment of the Loral Advanced Synthetic Aperture Radar System (ASARS). This advanced digitized radar system, with a resolution of less than one foot at nadir, enabled imagery to be transmitted in real time/near real time direct to the end user. This capability was demonstrated by Det 2 and it could have been deployed operationally much earlier if the programme hadn't been starved of funds by the so-called 'Fighter Mafia' that held the balance of power in the Pentagon during the late 1980s–early 1990s, and that ultimately allocated Air Force funding accordingly. These same generals (as well as senior officials of other US intelligence agencies) were the ones who argued that the aircraft was far more expensive to operate than any other aircraft in the inventory…of course it was! That's because no other aircraft in the inventory could anything like what the SR-71 and its sensors could do. As Habu pilot Mac McKendree observed, 'It's not an airplane. It's an air breathing manned suborbital satellite. Everything about it is unique, fuel, hydraulic fluid, tyres, screws, fasteners, titanium construction et al. If you want to compare the SR costs to something, it's the Space Shuttle.'

Aircrew selection for the Senior Crown programme was always hotly contested as they were all unquestionably at the top of their game – they had to be. The demanding mission, the complexity of the aircraft and its systems, combined with operating in a 'thermal thicket', resulted in crews suffering at least one, sometimes multiple, major systems failures during the course of their tour, that could easily have resulted in the loss of an aircraft. Evidence clearly demonstrates that many more SR-71s would have been lost in accidents were it not for their skill and the robust, constantly evolving and challenging training that crews received – particularly in the flight simulator which pushed them to their limit. Consequently, crewmembers entering the Senior Crown programme with the rank of major were usually promoted to lieutenant colonel upon completing their tour. However, all that changed with the arrival of General Larry Welch as Air Force Chief of Staff and his cohorts. As a result, the last six aircrew that entered the programme as majors were all passed over for promotion – the rumour was that their personnel folders were never passed to the promotion board. Unsurprisingly, this had a demoralizing effect on their pride and a detrimental impact on their salary and pension. Follow-on assignments for pilots at this time were career-ending and as a result, most left the Air Force to fly for the airlines.

Politically, the sensitive nature of the A-12's and SR-71's intelligence gathering role meant that US State Department officials had to be aware of the possible implications to US foreign relations when these aircraft were deployed outside the United States. For example, before the deployment of Black Shield missions to Kadena AB, the State Department was mindful of possible Japanese sensitivities to such a move and first checked that it wouldn't damage US/Japanese relations. Due consideration was also given to how the People's Republic of China would react to the deployment – would it be perceived by them as an escalation of the conflict? Black Shield COMINT demonstrated how the Chicom air defence network worked with the North Vietnamese to provide early warning of an Oxcart mission. It also provided an absorbing insight into the evolution of techniques used by the North Vietnamese and their Soviet advisors on how best to affect a successful SA-2 intercept on the Oxcart. Similar diplomatic efforts were necessary when it came to operating in the UK and Europe. France, for example, was particularly sensitive about even granting the SR-71 permission to overfly their airspace when enroute to monitor target areas in the Mediterranean – despite their supposed close links to NATO.

The SR-71's ability to survive in a high threat environment was equally useful when it came to 'diplomacy'. There were a number of occasions where an SR-71 was directed to overfly a country not primarily to gather intelligence but to lay down its unique triple-sonic boom. It was a way of sending a message to some of the world's 'flaky' dictators that 'Uncle Sam' has his eye on you and despite your bellicose rumblings there's nothing you can do about it!

Given what we now know, the 1960 shooting down of a U-2 by a Soviet SA-2 was an inevitability and a Soviet military and political success story. For the United States, the incident was a public embarrassment bordering on humiliation. It is not surprising that the date chosen by the USAF to reassert its aerospace prowess to the world was the fifth anniversary of that shoot-down when a YF-12 secured five world absolute speed and altitude records.

Nine years later, the SR-71 galvanized US pride during similar demonstrations, when in 1974, 61-7972 established the New York to London and London to Los Angeles world speed records. Two years later, during the 1976 bi-centennial celebrations, 61-7958 reclaimed three world, absolute speed and altitude records.

For many in the US Air Force, gaining entry into the SR-71 programme was aspirational – everyone involved in it was a cut above the rest – they had to be in order to be selected. This sense of being the best of the best was probably epitomized by the flight suits worn by crewmembers. Unlike their peers, who wore dark green, theirs were orange (not to mention their short-sleeved semi-official ‘display suits’). At least this was the case until the mid-Eighties, when it was decreed from those ‘on high’ that such a display was too elitist and ordered crews henceforth to wear dark green like everyone else.

FINALLY

It is people who can make or break any project and there is no doubt that those involved with the ‘Blackbirds’ were all of the highest calibre and real team players, totally focused on ensuring that the mission, whatever it may have been, was a success. As Pratt & Whitney’s Arnie Gunderson recalled, ‘Everyone I encountered on the Programme was proud of their role. From the Commander of the Wing to the Airman mopping up JP7 from under the wings, everyone demonstrated the highest degree of respect for their teammates’.

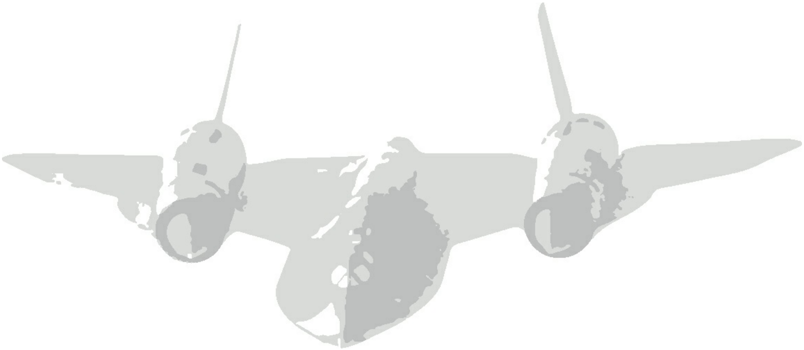
In the final analysis, it can be argued that the Senior Crown programme was terminated at least five years earlier than necessary. Indeed, had it received the technology packages that already existed and were demonstrated during the period in which it was briefly reactivated under Det 2 at Edwards Air Force Base, from 5 January 1995 to 10 October 1997, Kelly would have been bang on the money, when he predicted that his platform could perform its duty to the intelligence community and the national leadership until 2001.

At the time of writing this, there’s a war in Europe. If history teaches us anything, it is that we should never take democracy for granted and that dictators should never be appeased. History is important, as Winston Churchill wrote, ‘The farther back you can look, the farther forward you are likely to see.’ We ignore mistakes made in history at our peril.

APPENDICES

APPENDIX 1:

BLACK SHIELD MISSIONS



Date	Mission	Target	Pilot	Article	Duration/hours	Alt/ft
31/05/67	BSX001	North Vietnam	Vojvodich	131	3:55	80K
10/06/67	BSX003	North Vietnam	Weeks	131	4:58	82K
20/06/67	BX6705	North Vietnam	Layton	127	4:58	82K
30/06/67	BX6706	North Vietnam	Weeks	129	4:58	82K
13/07/67	BX6708	North Vietnam	Collins	127	3:40	82.1K
19/07/67	BX6709	North Vietnam	Sullivan	131	4:58	82K
20/07/67	BX6710	North Vietnam	Collins	129	4:55	82.45K
21/08/67	BX6716	North Vietnam	Vojvodich	131	4:58	82K
31/08/67	BX6718	North Vietnam	Layton	127	5:12	81K
16/09/67	BX6722	North Vietnam	Weeks	129	4:01	80K
17/09/67	BX6723	North Vietnam	Collins	131	4:00	81K
04/10/67	BX6725	North Vietnam	Collins	127	4:09	81K
06/10/67	BX6727	North Vietnam	Murray	131	2:20	81K
15/10/67	BX6728	North Vietnam	Collins	131	3:41	81K
18/10/67	BX6729	North Vietnam	Murray	129	4:01	81K
28/10/67	BX6732	North Vietnam	Sullivan	131	3:49	83.5K
29/10/67	BX6733	North Vietnam	Murray	127	3:56	82K

30/10/67	BX6734	North Vietnam	Sullivan	129	3:44	85K
08/12/67	BX6737	Cambodia/Laos	Vojvodich	131	3:59	82.5K
10/12/67	BX6738	Cambodia/Laos	Layton	131	3:51	81K
15/12/67	BX6739	North Vietnam	Vojvodich	127	4:09	86K
16/12/67	BX6740	North Vietnam	Layton	131	3:56	86.2K
04/01/68	BX6842	North Vietnam	Layton	127	3:57	85.1K
05/01/68	BX6843	North Vietnam	Weeks	131	4:09	86K
26/01/68	BX6847	North Korea	Weeks	131	4:00	83.5K
16/02/68	BX6851	North Vietnam	Collins	127	3:54	85.6K
19/02/68	BX6853	North Korea	Murray	127	3:39	83.5K
08/03/68	BX6856	North Vietnam	Vojvodich	127	4:01	85.5K
06/05/68	BX6858	North Korea	Layton	127	3:30	84.7K

APPENDIX 2:
BLACK SHIELD ELINT LOG

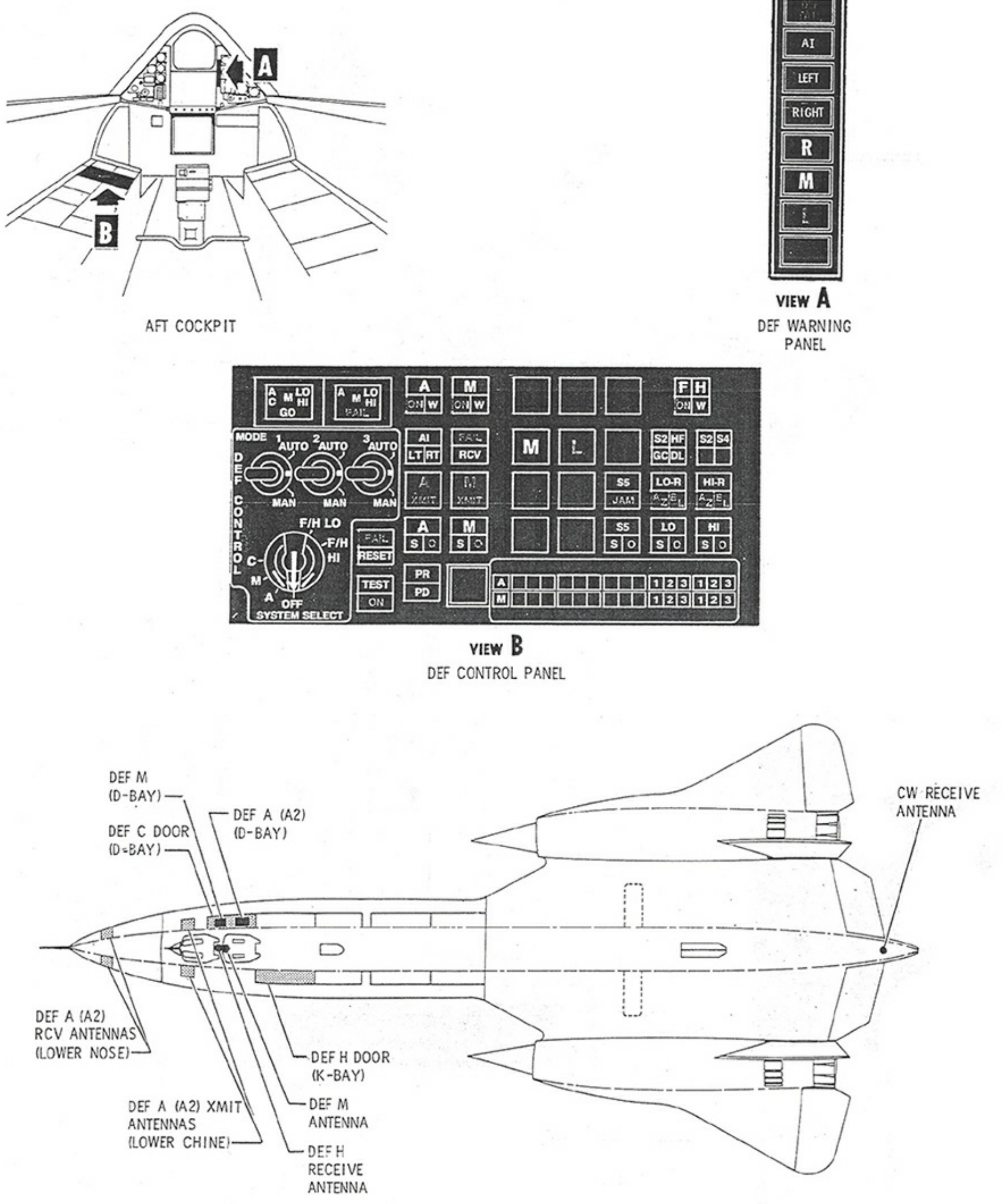
Black Shield Electronic Support Measures (ESM) Log																							
BSX & BX 67 Missions																							
Nato Codename	Radar Type	01	03	05	06	08	09	10	16	18	22	23	25	27	28	29	32	33	34	37	38	39	40
Fan Song	Fire Control				6	4	9		17	8	2	5	4	7	1	1	7	8	12			3	6
Spoon Rest A	Early Warning	6				3						1	1	2		5	1		2		1	4	4
Token-Big Mesh	Early Warning	5	3	1		4																	
Token	Early Warning								6		5	2	1	1		1	4	2	1		1	1	1
Big Mesh	Early Warning				6		1		1	2	3	1	1	1				3			1	1	
Cross Slot (Token)	Early Warning			1	7		4	7	1		14	2	1		1	2	2		3		3	7	
Rock Cake	Height Finder				10	1	9	11	6	6	10	15	6	8	7	15	14	11	16	4	4	8	10
Token V-Beam	Early Warning				2	4	3	4															
Fire Can	AAA Fire Control				1	1	5	4	4	5	3	3					1	6	2			3	5
Flat Face	Target Acquisition				1	4	7	9	5	5	1						3	2	3	2		5	1
Moon Cone	Early Warning					1	4	6	1		2				1		6	1	1		4		
Moon Face	Early Warning						2	16	11		5	16	2	4			10	9	4	2	7		4
Cross Legs	Early Warning						1											2					
Whiff	AAA Fire Control							4	6			1		1				2					3
Rice Cake	Height Finder																						
Bar Lock	Early Warning/GCI											1	2		6	1	4	3	5	3		5	10
Tall King	Early Warning																						
Moon Mat II	Search Radar											1	1								1		3

Side Net	Height Finder									1		1					1					1	
One Eye	?																						
Long Talk	Precision Approach																						

Black Shield Electronic Support Measures (ESM) Log								
BX 68 Missions								
Nato Codename	Radar Type	42	43	47	51	53	56	58
Fan Song	Fire Control	4	11					
Spoon Rest A	Early Warning			2				
Token-Big Mesh	Early Warning							
Token	Early Warning			11	1	9		3
Big Mesh	Early Warning			5	2	7		2
Cross Slot (Token)	Early Warning	2	2	13	1	6	8	2
Rock Cake	Height Finder	10	17	9	4	10	14	4
Token V-Beam	Early Warning							
Fire Can	AAA Fire Control	2	2	7	1			
Flat Face	Target Acquisition	2	2	1	2		2	
Moon Cone	Early Warning	2	2	1	2	2		9
Moon Face	Early Warning	2	2	7	2	5		3
Cross Legs	Early Warning	3	2				1	2
Whiff	AAA Fire Control			6				
Rice Cake	Height Finder					1		
Bar Lock	Early Warning/GCI	1	1	6	2		1	11
Tall King	Early Warning			1		1		
Moon Mat II	Search Radar							
Side Net	Height Finder			2		1	3	2
One Eye	?							1
Long Talk	Precision Approach							1

APPENDIX 3:
DEF LOCATIONS

DEF EQUIPMENT LOCATION



AFT COCKPIT

VIEW A
DEF WARNING PANEL

VIEW B
DEF CONTROL PANEL

A
B
AI
LEFT
RIGHT
R
M
L
A C M LO HI GO
A M LO HI FAIL
A ON W
M ON W
F H ON W
MODE
1 AUTO
2 AUTO
3 AUTO
MAN
DEF CONTROL
AI LT RT
FAIL RCV
M
L
S2 HF GC DL
S2 S4
A XMIT
M XMIT
S5 JAM
LO-R AZ EL
HI-R AZ EL
F/H LO
F/H HI
C
M
A
OFF
SYSTEM SELECT
FAIL RESET
TEST ON
A S O
M S O
S5 S O
LO S O
HI S O
PR
PD
A 1 2 3 1 2 3
M 1 2 3 1 2 3
DEF M (D-BAY)
DEF C DOOR (D-BAY)
DEF A (A2) (D-BAY)
CW RECEIVE ANTENNA
DEF A (A2) RCV ANTENNAS (LOWER NOSE)
DEF H DOOR (K-BAY)
DEF A (A2) XMIT ANTENNAS (LOWER CHINE)
DEF M ANTENNA
DEF H RECEIVE ANTENNA

F203-209(c)

APPENDIX 4:
DET 1 DEPLOYMENTS

Serial Number	Deployment Date	Redeployment Date
61-7958	17 July 1980	16 July 1981
	11 June 1985	06 April 1986
61-7960	10 August 1977	23 June 1979
	04 September 1980	15 July 1981
	12 November 1982	20 November 1983
61-7961	18 August 1972	07 June 1973
	16 August 1974	21 July 1976
61-7962	18 September 1968	25 April 1969
	06 June 1973	20 August 1974
	22 June 1979	19 July 1980
	09 June 1989	21 January 1990
61-7963	21 August 1972	13 June 1973
	13 August 1974	16 July 1976
61-7964	15 December 1983	30 March 1984
	11 December 1984	01 August 1985
61-7967	14 August 1977	03 August 1979
	16 July 1981	30 June 1982
	04 April 1986	20 Nov 1987
61-7968	10 June 1971	19 August 1972
	12 June 1973	14 August 1974
	31 July 1985	14 May 1987
61-7969	24 September 1969	10 May 1970 Crashed
61-7970	15 September 1968	22 April 1969
61-7971	18 April 1969	01 October 1969
	14 August 1972	10 June 1973
	26 November 1974	14 July 1976
61-7972	30 September 1969	11 June 1971

	15 July 1976	11 August 1977
	19 July 1979	21 June 1980
61-7973	27 September 1969	08 June 1971
	27 March 1984	26 June 1985
61-7974	13 March 1968	16 September 1968
	21 September 1969	14 June 1971
	19 November 1987	21 April 1989 Crashed
61-7975	24 April 1969	22 October 1969
	18 December 1970	17 June 1971
	11 August 1972	04 June 1973
	12 August 1977	20 July 1979
	14 July 1981	17 February 1983
	13 May 1987	30 June 1988
61-7976	11 March 1968	13 September 1968
	20 July 1976	09 August 1977
	24 June 1980	07 June 1982
	19 November 1983	13 March 1984
61-7978	09 March 1968	19 September 1968
	16 June 1971	20 July 1972 Crashed
61-7979	21 April 1969	25 September 1969
	13 June 1971	12 August 1972
	13 July 1976	13 August 1977
	02 August 1979	05 September 1980
	03 July 1988	12 August 1988
61-7980	12 September 1968	19 April 1969
	19 June 1971	15 August 1972
	06 June 1982	13 November 1982

For detailed flight log information for Detachment 1, see website sr71.com/paulcrickmore

APPENDIX 5:
DET 4 DEPLOYMENTS

Serial Number	Deployment Date	Redeployment Date
61-7955	09 July 1983	30 July 1983 (False serial 962)
61-7958	07 January 1977	17 January 1977
	16 May 1977	31 May 1977
	09 September 1983	12 June 1984
	16 December 1981	21 December 1981
61-7960	29 October 1985	29 January 1987
61-7962	06 September 1976	18 September 1976
	19 October 1984	23 October 1985
61-7964	24 April 1978	12 May 1978
	16 October 1978	02 November 1978
	12 December 1980	07 March 1981
	16 August 1981	06 November 1981 (Div from Bodø)
	05 February 1987	03 March 1988
	05 October 1988	18 January 1990 *
61-7967	02 March 1989	19 January 1990
61-7971	23 December 1982	02 February 1983
	13 March 1988	28 February 1989
61-7972	09 September 1974	13 September 1974
	20 April 1976	30 April 1976
	12 March 1979	28 March 1979
	13 September 1980	02 November 1980
	06 March 1981	05 May 1981
	18 December 1982	06 July 1983
61-7973	01 November 1986	22 July 1987 (For repairs)
61-7974	30 April 1982	13 December 1982
	02 August 1983	16 July 1984
61-7975	18 July 1984	16 October 1984

61-7976	24 October 1977	16 November 1977
	18 October 1979	13 November 1979
	09 April 1980	09 May 1980
61-7979	17 April 1979	02 May 1979
	14 June 1984	17 July 1985
61-7980	05 January 1982	27 April 1982
	07 March 1983	06 September 1983
	19 July 1985	29 October 1986
	27 July 1987	03 October 1988 (From Lakenheath)
* This aircraft completed an operational mission into the Barents Sea after several fly-bys at Mildenhall upon its departure, despite the fact that the programme had been terminated the previous November.		

For detailed flight log information for Detachment 4, see website sr71.com/paulcrickmore

APPENDIX 6:
BLACKBIRD DISPOSITION

A12

Tail No	LAC No.	First Flight	Last Flight	No. of Flights	Total Hours
60-6924	121	26 April 1962	?	322	418.2
	Remarks	Prototype, now on display at the Blackbird Air Park, Palmdale, CA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6925	122	?	?	161	177.9
	Remarks	Displayed on board the Intrepid Sea, Air & Space Museum, New York City, NY.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6926	123	?	24 May 1963	79	135.3
	Remarks	Crashed 24 May 1963: pilot Ken Collins survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6927	124	?	?	614	1076.4
	Remarks	Displayed at California Science Center, Los Angeles, CA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6928	125	?	5 Jan 1967	202	334.9
	Remarks	Crashed 5 Jan 1967: pilot Walter Ray killed.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6929	126	?	28 Dec 1967	105	169.2

	Remarks	Crashed 28 Dec 1967: pilot Mel Vojvodich survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6930	127	?	?	258	499.2
	Remarks	Displayed at the US Space and Rocket Center, Huntsville, AL.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6931	128	?	?	232	453
	Remarks	Displayed at CIA Headquarters, Langley, VA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6932	129	?	5 Jun 1968	268	409.9
	Remarks	Crashed 5 June 1968: pilot Jack Weeks killed.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6933	130	27 Nov 1963	Aug 1965	217	406.3
	Remarks	Displayed at the San Diego Aerospace Museum, CA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-937	131	?	?	177	345.8
	Remarks	Displayed at the Southern Museum of Flight, Birmingham, AL.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6938	132	?	?	197	369.9
	Remarks	Displayed at the USS Alabama Battleship Memorial Park, Mobile, AL.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6939	133	?	?	10	8.3
	Remarks	Crashed 9 July 1964: pilot Bill Park survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-	134	?	?	80	123.9

6940					
	Remarks	Converted to M-21 to carry D-21 drone. Displayed at the Museum of Flight, Seattle, WA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**No. of Flights**	**Total Hours**
60-6941	135	?	30 Jul 1966	95	152.7
	Remarks	Converted to M-21 to carry D-21 drone. Crashed 30 July 1966: pilot Bill Park survived, Launch Control Officer Ray Torick killed.			

YF-12A

Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
60-6934	1001	8 Aug 1963	14 Aug 1966	Jim Eastham	180.9
	Remarks	Converted into SR-71 trainer, referred to as SR-71C and given the serial number 61-7981, displayed at Hill AFB Utah.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
60-6935	1002	26 Nov 1963	7 Nov 1979	Lou Schalk	534.7
	Remarks	Displayed at the National Museum of the US Air Force, Wright-Patterson AFB, OH.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
60-6936	1003	13 Mar 1964	24 Jul 1971	Bob Gilliland	439.8
	Remarks	Crashed 24 July 1971: pilot Jack Layton and FCO Bill Curtis both survived.			

SR-71

Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7950	2001	23 Dec 1964	10 Jan 1967	Bob Gilliland	?
	Remarks	Written off on 10 Jan 1967: pilot Art Peterson survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7951	2002	5 Mar 1965	22 Dec 1978	Gilliland/Zwayer	796.7
	Remarks	Displayed at the Pima Air Museum, Tucson, AZ.			

Tail No	LAC No.	First Flight	Last Flight	First Flt Crew	Total Hours
61-7952	2003	24 Mar 1965	25 Jan 1966	?	?
	Remarks	Crashed 25 Jan 1966: pilot Bill Weaver survived, RSO Jim Zwayer killed.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7953	2004	4 Jun 1965	18 Dec 1969	Weaver/Andre	?
	Remarks	Crashed 18 Dec 1969: pilot Joe Rogers and RSO Gary Heidelbaugh both survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7954	2005	20 Jul 1965	11 Apr 1969	Weaver/Andre	?
	Remarks	Written off 11 April 1969: pilot Bill Skliar and RSO Noel Warner both survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7955	2006	17 Aug 1965	24 Jan 1985		
	Remarks	Displayed at the Air Force Flight Test Center Museum, Edwards AFB, CA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7956	2007			Gilliland/Belgau	3,760
	Remarks	Displayed at the Kalamazoo Air Museum, Kalamazoo, MI.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7957	2008	18 Dec 1965	11 Jan 1968	Gilliland/Eastham	?
	Remarks	SR-71B crashed 11 Jan 1968: instructor pilot Robert Sowers and student Dave Fruehauf both survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7958	2009	15 Dec 1965	23 Feb 1990	Weaver/Andre	2, 288.9
	Remarks	Displayed at the Museum of Aviation, Robbins AFB, GA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7959	2010	19 Jan 1966	29 Oct 1976	Weaver/Andre	866.1
	Remarks	Displayed at the Air Force Armament Museum, Eglin AFB, FL.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7960	2011	9 Feb 1966	27 Feb 1990	Weaver/Andre	2, 699.6
	Remarks	Displayed at the Castle Air Museum Foundation, Castle AFB, CA.			

Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7961	2012	13 Apr 1966	2 Feb 1977	Weaver/Andre	1,601
	Remarks	Displayed at the Cosmosphere and Space Center, Hutchison, KS.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7962	2013	29 Apr 1966	14 Feb 1990	Weaver/Belgau	2,835.9
	Remarks	Displayed at the Imperial War Museum, Duxford, UK.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7963	2014	9 Jun 1966	28 Oct 1976	Weaver/Belgau	1,604.4
	Remarks	Displayed at the Heritage Park, Beale AFB, CA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7964	2015	11 May 1966	20 Mar 1990	Weaver/Belgau	3,373
	Remarks	Displayed at the Strategic Air and Space Museum, Ashland, NE.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7965	2016	10 Jun 1966	25 Oct 1976	Weaver/Moeller	?
	Remarks	Crashed 25 Oct 1967: both pilot Roy St Martin and RSO John Carnochan survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7966	2017	1 Jul 1966	13 Apr 1967	Gilliland/Belgau	?
	Remarks	Crashed 13 April 1967: both pilot Earle Boone and RSO ‘Butch’ Sheffield survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7967	2018	3 Aug 1966	14 Feb 1990	Weaver/Andre	236.8
	Remarks	Displayed at the Barksdale Global Power Museum, Barksdale AFB Museum, LA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7968	2019	3 Aug 1966	12 Feb 1990	Weaver/Andre	2,279
	Remarks	Displayed at the Virginia Aviation Museum, Richmond, VA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7969	2020	18 Oct 1966	10 May 1970	Weaver/Belgau	?
	Remarks	Crashed 10 May 1970: pilot Willie Lawson and RSO Gil Martinez survived.			
Tail No	**LAC**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**

	No.				
61-7970	2021	21 May 1966	17 Jun 1970	Weaver/Belgau	?
	Remarks	Crashed 17 June 1970: pilot Buddy Brown and RSO Mort Jarvis survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7971	2022	17 Nov 1966	Still flying	Weaver/Moeller	3,512.5
	Remarks	Displayed at the Evergreen Aviation & Space Museum, McMinnville, OR.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-17972	2023	12 Dec 1966	6 Mar 1990	Weaver/Belgau	2801
	Remarks	Displayed at the Udvar-Hazy Gallery, Smithsonian Air and Space Museum, Chantilly, VA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
64-7973	2024	8 Feb 1967	21 July 1987	Weaver/Greenamyer	1,729.9
	Remarks	Displayed at the Blackbird Airpark, Palmdale, CA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7974	2025	16 Feb 1967	21 April 1989	Weaver/Belgau	?
	Remarks	Crashed 21 April 1989: pilot Dan House and RSO Blair Bozek survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7975	2026	13 Apr 1967	28 Feb 1990	Greenamyer/Belgau	2,854
	Remarks	Displayed at March Field Museum, Riverside, CA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7976	2027	? May 1967	27 Mar 1990	Gilliland/Belgau	2,985.7
	Remarks	Displayed at the National Museum of the US Air Force, Wright-Patterson AFB, OH.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7977	2028			Gilliland/Greenamer	
	Remarks	Written off 10 Oct 1968: pilot ‘Abe’ Kardong and RSO Jim Kogler survived.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7978	2029			Weaver/Belgau	
	Remarks	Written off 20 July 1972: pilot Deny Bush and RSO Jimmy Fagg survived.			
Tail No	**LAC**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**

	No.				
61-7979	2030	10 Aug 1967	6 Mar 1990	Greenmyer/Belgau	3,321.7
	Remarks	Displayed at the History and Traditions Museum, Lackland AFB, TX.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7980	2031	25 Sep 1967	5 Feb 1990	Gilliland/Belgau	2,255.6
	Remarks	Displayed at the NASA Dryden Flight Research Center, Edwards AFB, CA.			
Tail No	**LAC No.**	**First Flight**	**Last Flight**	**First Flt Crew**	**Total Hours**
61-7981	2000	14 Mar 1969	11 Apr 1976	Gilliland/Belgau	556.4
	Remarks	So-called SR-71C, trainer replacement, displayed at Hill AFB, UT.			

APPENDIX 7:
SR-71 COMMANDERS AND AWARDS

9TH STRATEGIC RECONNAISSANCE WING COMMANDERS

Name	From	To
Col Douglas T. Nelson	Jan 1966	Dec 1966
Col William R. Hayes	Jan 1967	Jun 1969
Col Charles E. Minter	Jun 1969	Jun 1970
Col Harold E. Confer	Jul 1970	May 1972
Col Jerome F. O'Malley	May 1972	May 1973
Col Patrick J. Halloran	May 1973	Jun 1975
Col John H. Storrie	Jul 1975	Sep 1977
Col Lyman M. Kidder	Sep 1977	Jan 1979
Col Dale Shelton	Feb 1979	Jul 1980
Col David Young	Jul 1980	Jul 1982
Col Thomas S. Pugh	Jul 1982	Jul 1983
Col Hector Freese	Aug 1983	Jan 1985
Col David H. Pinsky	Jan 1985	Jul 1987
Col Richard H. Graham	Jul 1987	Nov 1988
Col James Savarda	Dec 1988	Jun 1990
Col Thomas J. Keck	Jun 1990	Nov 1991
Col Richard Young	Nov 1991	Jun 1993
Col Larry Tieman	Jun 1993	Jul 1994
Gen John Rutledge	Jul 1994	Sep 1995
Gen Robert Behler	Sep 1995 (Final SR-71)	

9TH SRW VICE WING COMMANDERS

Name	From	To
Col Marvin L. Speer	Jan 1966	Dec 1966
Col Charles F. Minter	Dec 1966	Jun 1969

Col Harold E. Confer	Jun 1969	Jun 1970
Col James E. Anderson	Jul 1970	Dec 1971
Col Dennis B. Sullivan	Dec 1971	Jul 1972
Col Patrick J. Halloran	Jul 1972	Jun 1973
Col Donald A. Walbrecht	Jun 1973	May 1974
Col John H. Storrie	Jun 1974	Jun 1975
Col Robert D. Beckel	Jun 1975	Sep 1976
Col Lyman M. Kidder	Oct 1976	Sep 1977
Col William E. Lawson III	Sep 1977	Jan 1979
Col David G. Young	Feb 1979	Jul 1980
Col Thomas S. Pugh	Jul 1980	Jul 1982
Col Lonnie S. Liss	Jul 1982	Jan 1983
Col David H. Pinsky	Jan 1983	Jan 1985
Col Robert B. McConnell	Jan 1985	Jun 1986
Col Richard H. Graham	Jun 1986	Jul 1987
Col Donald R. Schreiber	Aug 1987	Aug 1989
Col Tom Atkinson	Aug 1989	Jun 1990
Col Rich Salsbury	Jun 1990	Jul 1991
Col Rich Young	Jul 1991	Nov 1991
Col Larry Tieman	Nov 1991	Jun 1993
Col Buz Carpenter	Jun 1993	Jan 1995
Col George Lafferty	Jan 1995	Aug 1995
Col Dale Smith	Aug 1995 (Final SR-71)	

1ST STRATEGIC RECONNAISSANCE SQUADRON COMMANDERS

Name	**From**	**To**
Lt-Col William R. Griner	Jan 1966	Mar 1966
Lt-Col Harold E. Confer	Apr 1966	Oct 1966
Lt-Col Raymond Haupt	Nov 1966	Jul 1967
Lt-Col Alan L. Hichew	Jul 1967	Sep 1968
Lt-Col Patrick J. Halloran	Sep 1968	Nov 1969
Lt-Col James L. Watkins	Dec 1969	Mar 1971
Lt-Col Harlon A. Hain	Apr 1971	Jul 1971

Lt-Col Larry S. DeVall	Jul 1971	Jan 1972
Lt-Col Kenneth S. Collins	Jan 1972	Jun 1972
Lt-Col George M. Bull	Jun 1972	Jul 1973
Lt-Col Brian K. McCallum	Jul 1973	Jan 1974
Lt-Col James H. Shelton Jr	Jan 1974	Aug 1975
Lt-Col Raphael S. Samay	Aug 1975	Jun 1977
Lt-Col Adolphus H. Bledsoe	Jul 1977	Dec 1978
Lt-Col Randolph B. Hertzog	Dec 1978	Dec 1979
Lt-Col Richard H. Graham	Jan 1980	Jul 1981
Lt-Col Eldon W. Joersz	Aug 1981	Jul 1983
Lt-Col Alan B. Cirino	Jul 1983	Aug 1985
Lt-Col Joseph Kinego	Aug 1985	Aug 1987
Lt-Col William D. Orcutt	Aug 1987	Nov 1988
Lt-Col William R. Dyckman	Nov 1988	Jun 1990

99TH STRATEGIC RECONNAISSANCE SQUADRON COMMANDERS

Name	From	To
Lt-Col John B. Boynton	Jun 1966	Dec 1967
Lt-Col Robert G. Sowers	Jan 1967	Mar 1968
Lt-Col John C. Kennon	Apr 1968	Nov 1969
Lt-Col Harlon A. Hain	Nov 1969	Mar 1971

DETACHMENT 2 COMMANDER, EDWARDS AIR FORCE BASE

Name	From	To
Col Stan Gudmundson	Oct 1995	Jun 1998

9TH STRATEGIC RECONNAISSANCE WING AWARDS DURING SR-71 OPERATIONS

PRESIDENTIAL UNIT CITATION	31 Mar 1968	31 Dec 1968
AIR FORCE OUTSTANDING UNIT AWARD	1 Jul 1970	30 Jun 1971
AIR FORCE OUTSTANDING UNIT AWARD,	1 Jul 1972	30 Jun 1973

WITH VALOR		
AIR FORCE OUTSTANDING UNIT AWARD	1 Jul 1974	30 Jun 1975
AIR FORCE OUTSTANDING UNIT AWARD	1 Jul 1975	30 Jun 1977
AIR FORCE OUTSTANDING UNIT AWARD	1 Jul 1981	30 Jun 1982
AIR FORCE OUTSTANDING UNIT AWARD	1 Jul 1983	30 Jun 1984
AIR FORCE OUTSTANDING UNIT AWARD	1 Jul 1985	30 Jun 1986
AIR FORCE OUTSTANDING UNIT AWARD	1 Jul 1986	30 Jun 1987
OL-8 was also awarded the REPUBLIC OF VIETNAM GALLANTRY CROSS & PALM, 31 Dec 1970		

APPENDIX 8:
AIR FORCE LOGISTICS COMMAND SR-71 FLIGHT CREW HISTORY

Pilots	**From**	**To**
Merv Evenson	Jan 1970	Jul 1974
Dick Gerard	Jan 1971	Jul 1973
Tom Pugh	Jul 1973	Jul 1978
T. Smith	Oct 1973	Jul 1975
B. Riedenauer	Nov 1973	Nov 1978
Jim Sullivan	Jul 1978	Aug 1980
Cal Jewett	Jul 1978	Jul 1982
Bob Helt	Jul 1980	Jul 1984
Tom Tilden	Feb 1982	Jul 1989
BC Thomas	Jul 1984	Dec 1987
Ed Yeilding	Jan 1988	Jan 1990
J. Halsell	Feb 1989	Jan 1990

RSO	**From**	**To**
Col Red McNeer	Jan 1970	Jul 1971
Ron Selberg	Jan 1971	Aug 1974
Coz Mallozzi	Jul 1971	Jul 1974
B. Frazier	Jul 1974	Jul 1980
John Carnochan	Aug 1974	Feb 1978
George Morgan	Jan 1978	Jul 1985
Bill ‘Flaps’ Flanagan	Jan 1980	Aug 1985
Joe Vida	Jan 1981	Jan 1990
P. Soucy	Jul 1985	Dec 1987
Tom Fuhrman	Dec 1987	Jan 1990

For individual flight log information conducted by AFLC during SR-71 test flights, see website sr71.com/paulcrickmore

APPENDIX 9:
CHRONOLOGY

1955	
4 August	First scheduled flight of the Lockheed U-2 completed at Area 51.
1956	
15 February	Lockheed Skunk Works begins work on Project Suntan for the US Air Force.
20 June	First CIA U-2 overflight of the Soviet Union.
10 July	First protest letter delivered to President Eisenhower following five U-2 incursions of Soviet sovereign airspace.
16 August	Project Rainbow begins in an attempt to render the U-2 ‘invisible’ to Soviet radar.
1957	
24 December Christmas Eve: first J58 engine run.	
1958	
January	Classified cryptonym Gusto assigned to phase two of Project Rainbow as design work begins to find a U-2 replacement.
February	Project Suntan is cancelled at Kelly Johnson’s insistence.
Spring	CIA invites Convair to participate in Project Gusto.
1959	
29 August	Lockheed’s A-12 design declared winner of Project Gusto competition and an advanced feasibility contract is awarded for what becomes Project Oxcart.
1960	
16/17 March	Kelly Johnson discusses the possibility of building an interceptor version of the A-12 for the US Air Force with the Air Force Secretary for R&D.
1 May	U-2 flown by CIA pilot Francis Gary Powers is shot down and captured during a clandestine overflight by a Soviet SA-2 Guideline Surface to Air Missile (SAM).
October	Lockheed receives letter to proceed with development of YF-12A interceptor in a programme codenamed Kedlock.
1961	
January	Kelly Johnson proposes RB-12 (RB for Reconnaissance Bomber) to USAF – this evolved into the RS-12 (RS for Reconnaissance Strike) but was a ‘paper only’ aircraft, i.e. a prototype was never built.
1962	

30 April	Lockheed Chief Test Pilot Lou Schalk successfully completes the A-12's first official flight. Due to early development problems, the aircraft was powered by two Pratt & Whitney J75 engines.
4 June	SR-71 mock-up reviewed by Air Force.
30 July	J58 completes pre-flight rating tests.
10 October	Skunk Works receives authorization to begin studies into building an unpiloted Mach 3+ drone, which evolved into the D-21.
27 October	USAF pilot Major Anderson shot down and killed by another SA-2 SAM while flying a U-2 over Cuba during the missile crisis.
6 December	Kelly Johnson begins work on his R-12 'Universal' aircraft. It was this design that was later designated SR-71.
1963	
15 January	First flight of an A-12 powered by two Pratt & Whitney J58 engines completed.
18 February	Lockheed awarded pre-contractual authority to build six R-12s (SR-71s) on the understanding that orders for an additional 25 would follow before 1 July.
24 May	First A-12 is lost during a test sortie – Ken Collins the CIA pilot safely ejects.
7 August	Jim Eastham successfully completes the first flight of a YF-12 from Area 51.
1964	
29 February	President Lyndon B. Johnson announces the existence of the 'A-11' (A-12) programme.
25 July	President Lyndon B. Johnson makes a second announcement confirming the existence of the SR-71 programme.
29 October	SR-71 prototype Article 2001 delivered to Palmdale.
7 December	Announcement that SR-71s are to be based at Beale AFB.
18 December	First engine run of prototype SR-71/J58s conducted at Palmdale.
21 December	SR-71 conducts taxi tests.
22 December	First flight of Tagboard D-21/M-21 combination flight from Area 51 by Bill Park.
22 December	First flight of SR-71 prototype from Palmdale by Bob Gilliland.
1965	
3 March	First flight of NASA 'YF-12C'.
18 March	YF-12A first AIM-47 missile.
1 May	YF-12A used to set nine world speed and altitude records.
1 June	SR-71/YF-12 Test Force formed at Edwards AFB.
7 July	First two T-38 companion trainers delivered to Beale AFB.
2 November	SR-71B maiden flight from Palmdale: pilot Bob Gilliland with Bill Weaver.
1966	
6 January	SR-71B pilot trainer delivered to USAF, flown by Ray Haupt and Charlie Bock.
7 January	SR-71B delivered to Beale by Ray Haupt and Doug Nelson.

25 January	First SR-71 is lost during Lockheed test sortie: pilot Bill Weaver survives but flight test engineer Jim Zwayer is killed.
10 May	First SR-71A delivered to 4200 SRW at Beale AFB.
25 June	4200 SRW redesignated 9 SRW.
3 July	First D-21 launched from M-21.
30 July	D-21/M-21 Tagboard programme terminated.
1967	
22 May	First of three A-12s deployed from Area 51 to Kadena AB, Okinawa, as part of Operation Black Shield to monitor North Vietnam.
31 May	Mele Vojvodich successfully completes the first ever operational mission on an A-12 in aircraft 60-6937 (Article 131).
1968	
5 January	Lockheed receives notification from US Air Force to cancel the YF-12A Kedlock programme.
11 January	SR-71B 61-7957 lost on approach to Beale.
26 January	First overflight of North Korea in A-12 made by Jack Weeks in aircraft 60-6937 (Article 131).
8 March	First of three SR-71As deployed on detachment to Kadena AB, Okinawa, ready for their first operational missions.
21 March	Majors Jerry O’Malley and his RSO Ed Payne successfully complete the first ever SR-71 mission in aircraft 61-7976.
25 May	Following 20 months of prevarication, a decision to terminate the A-12 Oxcart programme in favour of the SR-71 Senior Crown programme was finally endorsed by President Johnson and implemented.
26 July	First confirmed firing of two North Vietnamese SA-2s against an SR-71.
1 November	9th SRW receives the Air Force Outstanding Unit Award.
1969	
14 March	First flight of SR-71C – replacement pilot trainer.
13 April	9th SRW loses its first SR-71A.
1970	
16 January	SR-71/YF-12 Test Force redesignated 4786th Test Squadron.
11 December	YF-12 NASA/USAF test programme begins.
1971	
1 April	99th SRS deactivated as an SR-71 unit.
26 April	SR-71A completes 15,000-mile non-stop flight around US in 10 hours 30 minutes.
1973	
12/13 October	The first of nine SR-71 non-stop missions from the US east coast to the Middle East and back is successfully completed during the Yom Kippur War.

1974	
1 September	Current world speed record New York–London established by crews flying SR-71A serial 61-7972.
13 September	Current world speed record London–Los Angeles established by crews flying SR-71A serial 61-7972.
1976	
27/28 July	SR-71A serial 61-7958 establishes a series of world speed and altitude records.
6 September	Majors Rich Graham and Don Emmons complete the first SR-71A operational mission from the UK in aircraft 61-7962.
1978	
16 November	First SR-71 overflight of Cuba.
1979	
31 March	Det 4 of the 9th SRW formed at RAF Mildenhall.
31 October	NASA flight test programme ended.
7 November	YF-12A lands at Wright-Patterson AFB for US Air Force Museum.
1981	
1 August	4029th SRTS formed at Beale AFB to train SR-71 crews.
26 August	North Korea fires an SA-2 in an attempt to shoot down SR-71A 61-7976.
1984	
7 November	First SR-71 mission over Nicaragua.
1986	
13 April	The first of three SR-71A flights is successfully completed from the UK over Libya following Operation El Dorado Canyon.
1987	
22 July	First operational SR-71 flight from Kadena into the Gulf completed.
1989	
1 October	All USAF SR-71 operations suspended (except for minimum proficiency training sorties) while awaiting budget decision.
22 November	All USAF SR-71 operations terminated.
1990	
26 January	SR-71 decommissioned in ceremony at Beale AFB.
6 March	SR-71A 61-7972 flown by Lt Col Ed Yeilding and Lt Col J. T. Vida establishes current world speed record between the west and east coasts of the USA during positioning flight to Dulles Airport prior to being displayed at the Smithsonian Museum.
1995	

5 January	Limited reactivation plan for three SR-71s begins.
1996	
16 April	USAF once again suspends all SR-71 operations.
1997	
10 October	Final USAF SR-71 flight flown in 61-7967.
14 October	President Clinton line-item vetoes the limited SR-71 programme with immediate effect.
1999	
6 October	Detachment 2 of the 9th SRW deactivated.
9 October	NASA crew Rogers Smith and Bob Meyer flies SR-71A 61-7980 on the type’s final ever flight at the Edwards AFB Open Day.

APPENDIX 10:
LOSSES

A-12

Article No.	Remarks
123	Crashed 24 May 1963: pilot Ken Collins survived.
125	Crashed 5 Jan 1967: pilot Walter Ray killed.
126	Crashed 28 Dec 1967: pilot Mel Vojvodich survived.
129	Crashed 5 June 1968: pilot Jack Weeks killed.
133	Crashed 9 July 1964: pilot Bill Park survived.

M-12

Tail No.	Article No.	Remarks
60-6941	135	Converted to M-21 to carry D-21 drone. Crashed 30 July 1966: pilot Bill Park survived, Launch Control Officer Ray Torick was killed.

YF-12A

Tail No.	Article No.	Remarks
60-6936	1003	Crashed 24 July 1971: pilot Lt Col Jack Layton and Fire Control Officer Maj Bill Curtis both survived.

SR-71

Tail No.	Article No.	Remarks
61-7950	2001	Written off on 10 Jan 1967: pilot Art Peterson survived.
61-7952	2003	Crashed 25 Jan 1966: pilot Bill Weaver survived, Lockheed test engineer Jim Zwayer was killed.
61-7953	2004	Crashed 18 Dec 1969: pilot Joe Rogers and RSO Gary

		Heidelbaugh both survived.
61-7954	2005	Written off 11 April 1969: pilot Lt Col Bill Skliar and RSO Maj Noel Warner both survived.
61-7957	2008	SR-71B, crashed 11 Jan 1968: instructor pilot Lt Col Robert Sowers and student Capt Dave Fruehauf both survived.
61-7965	2016	Crashed 25 Oct 1967: both pilot Maj Roy St Martin and RSO Maj John Carnochan survived.
61-7966	2017	Crashed 13 April 1967: both pilot Maj Earle Boone and RSO Maj ‘Butch’ Sheffield survived.
61-7969	2020	Crashed 10 May 1970: both pilot Maj Willie Lawson and RSO Maj Gil Martinez survived.
61-7970	2021	Crashed 17 June 1970: both pilot Maj Buddy Brown and RSO Mort Jarvis survived.
61-7974	2025	Crashed 21 April 1989: both pilot Maj Dan House and RSO Capt Blair Bozek survived.
61-7977	2028	Written off 10 Oct 1968: both pilot Maj ‘Abe’ Kardong and RSO Jim Kogler survived.
61-7978	2029	Written off 20 July 1972: both pilot Maj Dennis Bush and RSO Maj Jimmy Fagg survived.

APPENDIX 11:
RECORDS

BLACKBIRD RECORDS

While reading the records established below that were verified at the time by the Federation Aeronautique Internationale (FAI), it should be remembered that impressive as these figures are, they are not demonstrations of the aeroplane's absolute capabilities. For example, on 20 November 1965, an A-12 attained speeds in excess of Mach 3.2 and a sustained altitude capability above 90,000ft. During the first operational deployment of a CIA A-12 from Area 51 to Kadena Air Base on the island of Okinawa, pilot Mele Vojvodich covered the distance in aircraft Article number 131 in just 6 hours 6 minutes; had it not been for security considerations, this could easily have been recognised as a new transpacific speed record. With the passage of time, several earlier SR-71 records were broken by a highly modified stripped-down Soviet MiG-25. However, the inability of that country to subsequently build an operational aircraft that represented a serious threat to the SR-71 provides a useful perspective on the research-only status of that particular jet.

Col Robert L. 'Fox' Stephens and his FCO, Lt Col Daniel Andre, set new absolute altitude and absolute speed records on 1 May 1965. (USAF)

YF-12A RECORDS

It's probably not a coincidence that the date chosen to demonstrate some of the YF-12's awesome capabilities was 1 May 1965 – exactly five years to the day after Francis Gary Powers was shot down by a Soviet SA-2 SAM while conducting an overflight in his U-2.

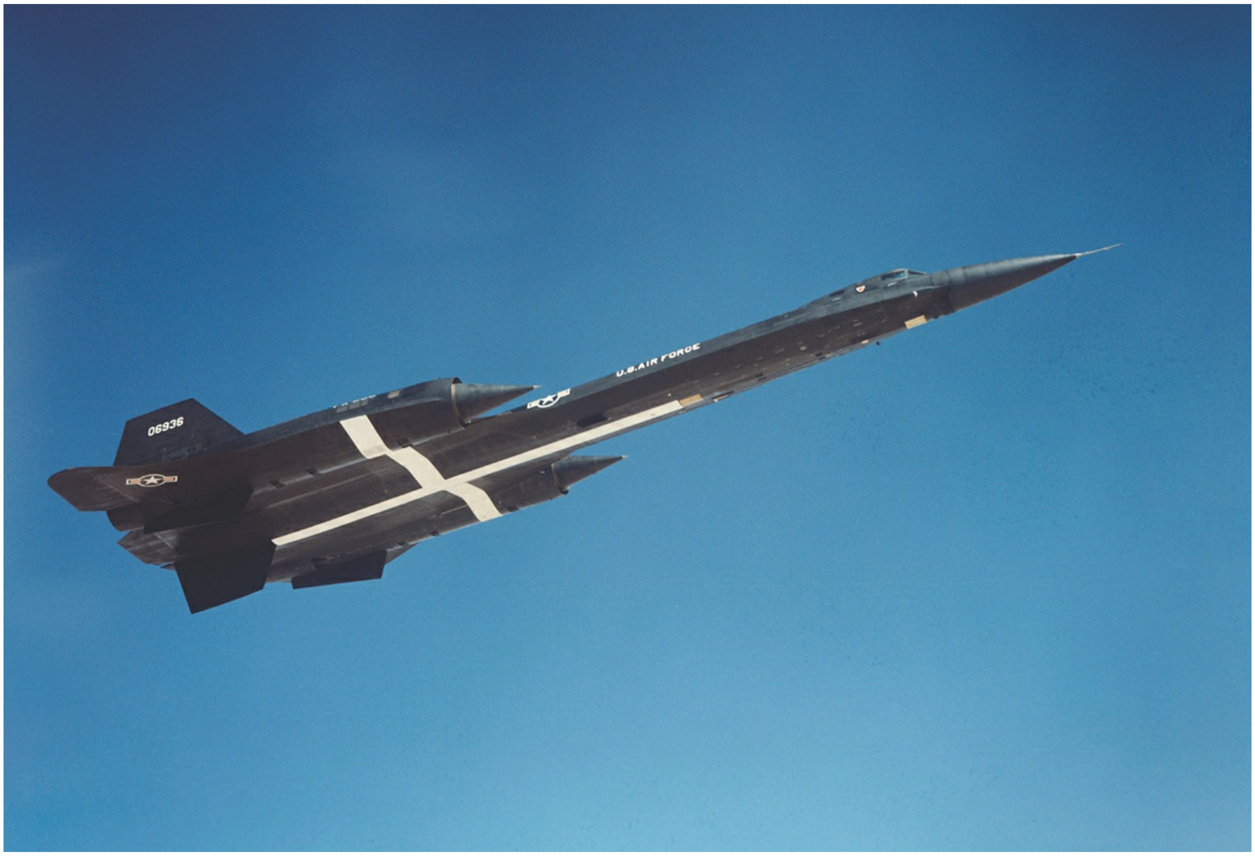
Record: Absolute altitude: 80,257.9ft.
Crew: Pilot Col Robert L. 'Fox' Stephens, FCO Lt Col Daniel Andre
Aircraft: YF-12A, 60-6936
Record: Absolute speed over a straight course: 2,070.1mph

Crew: Pilot Col Robert L. ‘Fox’ Stephens, FCO Lt Col Daniel Andre
Aircraft: YF-12A, 60-6936
Record: Absolute speed over a 500km closed course: 1,688.9mph
Crew: Pilot Lt Col Walter F. Daniel, FCO Maj James P. Cooney
Aircraft: YF-12A, 60-6936
Record: Absolute speed over a 1,000km closed course: 1,643.0mph
Crew: Pilot Lt Col Walter F. Daniel, FCO Maj Noel T. Warner
Aircraft: YF-12A, 60-6936

SR-71 RECORDS

The first big SR-71 attention-grabbing headline was undoubtedly the transatlantic speed records: they both still stand unbroken over 40 years later.

Record: 1 Sept 1974. Speed Over a Recognized Course – New York to London
Distance: 3,490 miles. Time 1hr 54mins 56.4secs
Crew: Pilot Maj James V. Sullivan, RSO Maj Noel F. Widdifield
Aircraft: SR-71A, 61-7972
Record: 13 Sept 1974. Speed Over a Recognized Course – London to Los Angeles
Crew: Pilot Capt Harold B. (Buck) Adams, RSO Capt William C. Machorek
Distance: 5,645 miles. Time 3hrs 47mins 39secs
Aircraft: SR-71A, 61-7972



Despite two aircraft being prepared for the 1 May 1965 record attempts, in the event YF-12A 60-6936 secured all of them. It is seen here climbing away with the gear being retracted and the centreline fin beginning to extend. (Lockheed Martin via Tony Landis)

The three record-breaking crews for July 1976 are pictured left-right, George 'GT' Morgan, Kelly Johnson, Al Joersz, Adolphus Bledsoe, John Fuller, Larry Elliott and Bob Helt. (Lockheed Martin)

Record: 28 July 1976. Altitude in Horizontal Flight, 85,068.997ft
Crew: Pilot Capt Robert C. Helt, Reconnaissance Systems Officer (RSO) Maj Larry A. Elliott
Aircraft: SR-71A, 61-7962
Record: 28 July 1976. Speed Over a Straight Course (15–25km): 2,193.167mph
Crew: Pilot Capt Eldon W. Joersz, RSO Maj George T. Morgan
Aircraft: SR-71A, 61-7958

Record: 28 July 1976. Speed Over a Closed Course (1,000km): 2,092.29mph.
Crew: Pilot Maj Adolphus H. Bledsoe, RSO Maj John T. Fuller
Aircraft: SR-71A, 61-7958

Finally, despite all that some Strategic Air Command officials could do to prevent more headline attention after the programme was prematurely closed down:

Record: 6 March 1990. Speed Over a Recognized Course – Los Angeles to East Coast.

Crew: Pilot Lt Col Ed Yeilding, RSO Lt Col Joseph T. Vida

COAST TO COAST (2,086 miles)	
Time	Average speed
1hr 07mins 53.7secs	2,144.83mph
LOS ANGELES TO WASHINGTON DC (1,998 miles)	
Time	Average speed
1 hour 4 minutes 19.89 secs	2,144.83mph
ST LOUIS TO CINCINNATI (311.44 miles)	
Time	Average Speed
8 minutes 31.97 secs	2,176.08mph
KANSAS CITY TO WASHINGTON DC (942.08 miles)	
Time	Average Speed
25 minutes 58.53 secs	2,176.08mph
Aircraft:- SR-71A 64-17972	

PSD specialists prepare Ed Yeilding and JT Vida for their US coast-coast, record-breaking flight on 6 March 1990. (Lockheed Martin)

General Al Joersz, a captain at the time of setting his 1976 record, recalls the

event:

The record-breaking flight was flown out of Beale AFB, unrefuelled, down to and over the Edwards AFB ranges and back. The criteria for breaking the record included the requirement to fly through a 25km course in level flight (we had to exit the course within 150ft of the entry altitude). After entering, we completed a 90/270 turn (which had us fly through three states, Arizona, Nevada and California): we then re-entered the course flying through in the opposite direction. In this instance the rules required that you again enter the course within 300ft of the first exit altitude and then leave within 150ft of the second entry altitude. While this may not seem like a big deal, flying at 80,600ft is more difficult than is readily apparent. The SR-71 is a cruise climb airplane, so the desired altitude for each pass was considerably different. For the first pass we had to be higher than desired and during the second we had to be lower than desired (we actually had to throttle back to keep from exceeding the max design limit of the airplane on the second pass.) We actually flew for the record on the 27th, but since weather precluded accurate altitude measurement of our flight, we were required to fly it again on the 28th. That flight was tracked satisfactorily, as was the counter. Actually during the flight on the first day (the 27th) we had an inlet unstart midway through the course at 3.3 Mach, which made our ability to stay within the 150ft altitude requirement problematic. No one ever said we exceeded the limit, but it was close at least. An unstart at any speed and condition is always interesting, but the one that day was even more unwelcome than normal. The airplane is pretty delicate to fly while at max speed and altitude and that day was no exception.

We were selected to fly the mission pretty much at random. We were one of the more senior crews available and since there were only nine qualified crews flying the airplane at that time and four of them were unavailable due to operational deployments, the chance of getting to do the record was pretty high. In any case, we were honoured and enjoyed the chance to put some new numbers in the books. We decided we would shoot for about 2,200mph, but our translation from nautical miles per hour [knots] to mph was a little off, so we ended up at 2,193 mph. Actually we flew the course at max compressor inlet temperature (CIT) limit for the airplane, so we didn't have much wiggle room to do more. The airplane we flew (tail number 958) was just one of the planes in the hangar. The only modification made was to paint a big white X on the bottom so that they could track us better with the cameras as we flew through the range at Edwards. (The Nun Baker cameras are the ones used to track the space shuttle when it comes in to land at Edwards and to photograph other test flights out of that facility).

ACRONYMS AND ABBREVIATIONS

AAA	Anti-Aircraft Artillery
AB	Air Base
ADP	Advanced Development Programs
ADS	Accessory Drive System
AEC	Atomic Energy Commission
AFB	Air Force Base
AFCS	Automatic Flight Control System
AFDAP	USAF Development and Advanced Planning
AFSC	Air Force Systems Command
AICS	Air Inlet Control System
ANS	Astro-inertial Navigation System
ARC	Ad-hoc Requirements Committee
ARCP	Air Refuelling Control Point
ARDC	Air Research and Development Command
ARS	Air Refuelling Squadron
ASARS	Advanced Synthetic Aperture Radar System
ASPO	Advanced Systems Project Office
BDA	Bomb Damage Assessment
BUFF	Big Ugly Fat F***er (B-52)
CAP	Combat Air Patrol
CAPRE	Capability Reconnaissance Radar
CG	Centre of Gravity
CIA	Central Intelligence Agency

CINC	Commander In Chief
CIT	Compressor Inlet Temperature
CIS	Chemical Ignition System
COMINT	Communications Intelligence
CP	Control Point
DAFICS	Digital Automatic Flight Inlet Control System
DCI	Director of Central Intelligence
DEF	Defensive Electronic System
DET	Detachment
DIA	Defence Intelligence Agency
DMZ	Demilitarized Zone
DOD	Department of Defense
DP	Destination Point
DPS	Development Projects Staff
ECM	Electronic Counter Measures
EIP	ELINT Improvement Program
ELINT	Electronic Intelligence
EMR	Electromagnetic Reconnaissance System
EOB	Electronic Order of Battle
FAA	Federal Aviation Administration
FCF	Functional Check Flight
FCO	Fire Control Officer
FISH	First Invisible Super Hustler
FMC	Forward Motion Compensation system
FOD	Foreign Object Damage
GCI	Ground Controlled Intercept
HEF	High Energy Fuel

HRR	High-Resolution Radar
HUMINT	Human Intelligence
IAC	Intelligence Advisory Committee
IFF	Identification Friend or Foe
IGV	Inlet Guide Vanes
IMINT	Imagery Intelligence
INS	Inertial Navigation System
IRBM	Intermediate Range Ballistic Missile
ISP	Intelligence Systems Panel
JCS	Joint Chiefs of Staff
KEAS	Knots Equivalent Air Speed
MPC	Mobile Processing Centre
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NIE	National Intelligence Estimate
NRO	National Reconnaissance Office
NSA	National Security Agency
OBC	Optical Bar Camera
ODM	Office of Defense Mobilization
OL	Operating Locations
OOC	Operational Objective Camera
OSA	Office of Special Activities
OSI	Office of Scientific Intelligence
PACAF	Pacific Air Force
PARPRO	Peacetime Aerial Reconnaissance Programme
PCS	Permanent Change of Station

PDM	Programmed Depot Maintenance
PEM	Programme Element Manager
PI	Photographic Interpreter
PIR	Product Improved Radar
POL	Petroleum Oil Lubricants
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
PSD	Physiological Support Division
R&D	Research and Development
RADINT	Radar Intelligence
RCD	Radar Correlator Display
RGPO	Range Gate Pull-Off
RTS	Reconnaissance Technical Squadron
RAM	Radar Absorbing Material
RCS	Radar Cross Section
RHAWR	Radar Homing and Warning Receiver
RSO	Reconnaissance Systems Officer Research Systems Operator (NASA ops only)
SAC	Strategic Air Command
SAFE	Semi-Automatic Ferret Equipment
SAM	Surface-to-Air Missile
SAS	Stability Augmentation System
SEI	Scientific Engineering Institute
SESP	Special Electronic Airborne Search Project
SIGINT	Signals Intelligence
SIOP	Single Integrated Operations Plan
SLAR	Sideways-Looking Airborne Radar

SPO	Systems Project Officer
SRC	Strategic Reconnaissance Center
SRS	Strategic Reconnaissance Squadron
SRW	Strategic Reconnaissance Wing
SSM	Surface-to-Surface Missiles
TACAN	Tactical Air Navigation System
TCP	Technological Capabilities Panel
TDI	Triple Display Indicator
TDY	Temporary Duty
TEB	Triethylborane
TELINT	Telemetry Intelligence
TEOC	Technical Objective Camera
TIT	Turbine Inlet Temperature
TOT	Time Over Target
TRS	Tactical Reconnaissance Squadron
UCD	Urine Collection Device
USAFE	US Air Forces Europe
WADC	Wright Air Development Center

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For detailed flight log information for Detachments 1 and 4, see website sr71.com/paulcrickmore

AUTHOR BIO

During his time at the London Air Traffic Control Centre, Paul F. Crickmore gained a unique introduction into SR-71 operations from RAF Mildenhall, Suffolk. Teaming up with Osprey, he produced the first in-depth book ever to be published on the aircraft. When additional information became available to him in 1990, following the initial shutdown of SR-71 operations, Paul produced an even more detailed book, Lockheed SR-71: The Secret Missions Exposed – the standard reference work on the subject. The book was acclaimed by the aviation press, Ben Rich (late president of the Skunk Works) and the crews that flew the SR-71, and was later updated to Lockheed Blackbird: Beyond the Secret Missions. This new edition is the final word on this extraordinary aeroplane.

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Front cover SR-71 ‘964 awaits clearance to roll on 17 December 1987. (Paul Crickmore)

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